ARI Research Note 96-72

The Army Research Institute's Enterprise Information Systems Architecture and Strategic Plan Support

A. Stickles, D. LeJeune, and S. Maple
Vector Research, Inc.

Information Systems Command--ARI
Nathaniel Speight, Chief

August 1996

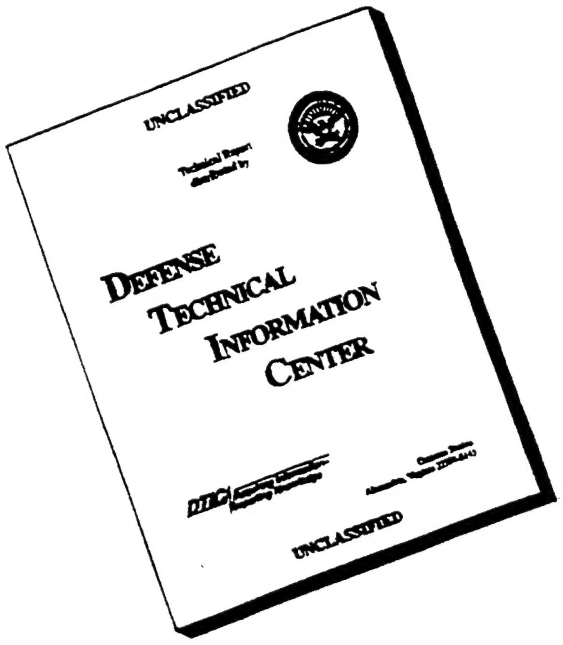
19970310 067

DTIC QUALITY INSPECTED 3

United States Army
Research Institute for the Behavioral and Social Sciences

Approved for public release; distribution is unlimited.

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

A Field Operating Agency Under the Jurisdiction of the Deputy Chief of Staff for Personnel

EDGAR M. JOHNSON
Director

Research accomplished under contract
for the Department of the Army

Vector Research, Inc.

NOTICES

DISTRIBUTION: This report has been cleared for release to the Defense Technical Information Center (DTIC) to comply with regulatory requirements. It has been given no primary distribution other than to DTIC and will be available only through DTIC or the National Technical Information Service (NTIS).

FINAL DISPOSITION: This report may be destroyed when it is no longer needed. Please do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The views, opinions, and findings in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other authorized documents.

REPORT DOCUMENTATION PAGE

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED (from. . . to)
1996, August	Final	August 1995-December 1995

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
The Army Research Institute's Enterprise Information Systems Architecture and Strategic Plan Support	DCA100-94-D-0014 DO 171
	5b. PROGRAM ELEMENT NUMBER 0605801A
6. AUTHOR(S)	5c. PROJECT NUMBER MM15
A. Stickles, D. LeJeune, and S. Maple (VRI)	5d. TASK NUMBER 9100
	5e. WORK UNIT NUMBER C02

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Vector Research, Inc. Computer Sciences Corporation Defense Enterprise Integrations Services 5113 Leesburg Pike, Skyline 4, Suite 700 Falls Church, VA 22041	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. MONITOR ACRONYM
U.S. Army Research Institute for the Behavioral and Social Sciences 5001 Eisenhower Avenue Alexandria, VA 22333-5600	ARI
	11. MONITOR REPORT NUMBER Research Note 96-72

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

COR: Nathaniel Speight

14. ABSTRACT *(Maximum 200 words)*:

This report documents the current automated capabilities of the U.S. Army Research Institute for the Behavioral and Social Sciences (ARI). It describes the hardware, software, and communications infrastructure currently in place to support the ARI community at ARI Headquarters in Alexandria, VA. In addition to the capabilities report, this document also includes a draft requirements report, an enterprise architecture report describing alternative information systems architecture components and a proposed ARI architecture, a migration implementation plan, and hard copy of a briefing on the implementation plan. Vector undertook this effort to baseline the current Automated Information Systems (AIS) infrastructure to determine how enhancements could be made to streamline operations and reduce overall life-cycle maintenance costs. The information will be applied to the design of a new AIS that will provide expanded capabilities and enhanced network connectivity for remote research units.

15. SUBJECT TERMS

ADPE Automated Information Systems LAN MILNET NIH DBMS DISA DISN FDDI ISDN SMP SMS Windows NT WAN WWW FTP

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON (Name and Telephone Number)
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	87	

ARI's Enterprise Information Systems Architecture and Strategic Plan Support

ARI Migration Implementation Plan

December 18, 1995

Prepared for:

U.S. Army Information Systems Command - Army Research Institute
ATTN: Mr. Nathaniel Speight
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

Contract Number: DCA100-94-D-0014
Delivery Order Number: 171
CDRL Number: A005

Prepared by:

Computer Sciences Corporation
Defense Enterprise Integration Services
Four Skyline Place
5113 Leesburg Pike, Suite 700
Falls Church, VA 22041

THIS DOCUMENT IS UNCLASSIFIED

Table of Contents

Section **Page**

Table of Contents

List of Tables

List of Appendices

SECTION 1

1.1 Introduction

The purpose of this document is to describe implementation of the selected information systems architecture components of the Army Research Institute (ARI) Enterprise Information Systems Architecture. The Enterprise Information Systems Architecture is described in terms of its computing, networking, and communications components.

1.2 Executive Summary

Based on a survey of ARI's existing information system capabilities and requirements, ARI's Enterprise Information System requirements can be best met with a client/server network consisting of Intel architecture-based Personal Computer (PC) workstations. These workstations must run some version of Microsoft Windows, preferably Windows 95 or Windows New Technology (NT). Intel architecture-based servers provide the file, print, mail, database, communications, and systems management services. The network topology must be capable of being segmented with routers to ensure that as network traffic increases, the traffic on each segment can be localized to its respective segment, not propagated throughout the entire network.

1.3 Conclusions

Upgrading ARI HQ to a client-server environment can be accomplished in two phases. Phase 1 consists of replacing the VAX with Intel architecture pentium-class servers, improved E-mail and remote access software, and standard workstation operating systems. Phase 1 can be accomplished in approximately seven months at a cost of approximately $385,000, which includes hardware, software and training costs of approximately $210,000, as well as labor costs approximating $175,000. Phase 2, consisting of replacing the network cable plant with 100 Mbs cable (fiber or Level 5 unshielded twisted pair), upgrading the routers between segments and replacing network interface cards in each ARI headquarters' workstation is recommended to be scheduled for the second year of the upgrade. The approximate cost for Phase 2 is $75,000, which includes both hardware and labor. The operating cost of the ARI HQ client-server environment is estimated to be $431,000, which is approximately one-half of the operating costs for the current centralized cluster-based architecture that it is replacing.

SECTION 2

2.1 AIS Migration

The migration of an automated information system (AIS) generally includes three areas of concentration; application, data, and infrastructure. The following paragraphs detail these areas as they apply to this implementation plan.

2.1.1 Application

The area of application migration usually involves planning and implementing the successful transition of an existing software application to a new platform. This migration plan for ARI HQ's migration from its current environment using a VAX cluster to a client-server environment does not address the issue of application migration. Several applications, such as IMIS and TIDMIS, reside on the VAX and will need migrated to the new environment. However, the addressing of those issues is outside of the scope of this project.

2.1.2 Data

The area of data migration involves coordination of data elements to promote efficiency and consistency within an organization. This migration plan does not address the issue of data migration. Those issues are being addressed outside of the scope of this project.

2.1.3 Infrastructure

The proposed ARI Information Systems Architecture infrastructure consists of hardware, software, communications, and cable plant. The details of those areas as they pertain to the ARI implementation at HQ are contained in the following paragraphs.

2.1.3.1 Hardware

The proposed Information Systems Architecture hardware consists of desktop workstations, printers, file servers, print servers, communications servers, World Wide Web (WWW) servers, file transfer protocol (FTP) servers, mail servers, and system management servers. The recommended minimum configuration for the listed hardware is detailed below.

- **Desktop Workstations**

  » Intel Personal Computer 486/33
  » 16 MB RAM expandable to 32 MB
  » 1 GB hard drive
  » CD ROM
  » 1.44 MB 3.5" disk drive
  » Sound Blaster-compatible audio
  » Windows 95 Operating System
  » MS Office Suite

- **Printers**

  » Current 16 HP Laserjet 4I printers will meet projected demands (next 5 years)
  » High-speed printer on ARI LAN (for general purpose use)
  » LAN Access to color printers

- **File Server Configuration**

  » Dual Pentium CPU with 64 MB memory and 10 GB storage (2 mirrored), CD ROM, and 1.44 MB 3.5" disk drive

- **Other Server Configuration (Print, Communication, WWW, FTP, Mail, and SMS)**

  » Single Pentium CPU
  » 64 MB memory
  » 2 GB storage
  » CD ROM
  » 1.44 MB 3.5" disk drive

2.1.3.2 Software

The proposed Information Systems Architecture software consists of desktop operating systems, network operating systems, mail server software, remote access server software, network management server software, and license management software. Recommended software follows.

- **Desktop Workstation Operating System**

  » MS Windows based (Windows 3.1 or Windows 95)

- **Network Operating System (NTAS)**

  » Macintosh and Intel CPU support
  » Enterprise-wide connectivity
  » File services
  » Print services
  » Remote access services
  » System management services

- **License Management Software**

  » License metering software to control software use
  » Software executables downloaded to workstations

- **Network Management Software**

  » Microsoft's SMS

- **Remote Access Server (RAS) Software**

  » RAS hosted on same server as WWW server and FTP server
  » RAS provides same type of service as ARI HQ's existing modem pool

- **E-Mail Server Software**

  » MS Mail
  » Internet Access
    * ARI's existing plans for Internet access provide sufficient bandwidth for next 2-5 years
    * If DISA reduces prices for T1 access to DISN, switch ARI from commercial access provider to DISA

2.1.3.3 Cable Plant

Based on current network activity measurements, the existing cable plant should be capable of providing sufficient bandwidth to support ARI until FY97/FY98. Phase 2 of this implementation plan lists replacing the current cable plant with 100 Mbs-capable fiber or Level 5 unshielded twisted pair cabling and installing routers between segments to localize traffic. This will establish a 100 Mbs cable plant that will provide ARI with necessary bandwidth requirements for over five years.

2.2 Legacy System Phasing and Transition

The VAX currently provides Mail, file and print, remote access (modem pool), and computing services to ARI. Additionally, the VAX supports several legacy software systems used by ARI for administration and budgeting.

2.2.1 Legacy Software

The legacy software migration plan is being developed separately from this implementation plan. For the purposes of this evaluation, the CSC Team used 1 October 1996 as the completion date for migration of legacy software from Oracle to Microsoft Access. That date was chosen because it is ARI HQ's target date for phasing out the VAX cluster at ARI HQ.

2.2.2 Mail Service

The ARI network staff can transition mail service off the VAX when the Microsoft Mail server is installed. The CSC Team recommends that the Mail server be the first server installed, thus, the first service phased off the VAX. It must be done concurrently with the transition to the new T1 Internet feed to minimize any problems associated with changes in e-mail addresses at ARI HQ.

2.2.3 Remote Access Services

Based on feedback from users, ARI must consider remote access a high priority migration. Most users feel that the current modem pool arrangement is not effective and too difficult to use. The CSC Team recommends the early installation of a communications server with NTAS and remote access services supporting a bank of high-speed (28.8 Mbs).

2.2.4 File and Print Service

Migration of file and print service must be phased incrementally by installing a new file/print server, then transitioning the assigned users to the segment where the new server is installed. After testing and error correction of the new server the process must be repeated for each of the two remaining server. The segment containing users of the Access database and the migrated VAX legacy software (primarily administrative and budgeting staff) is recommended as the last to transition to new servers to minimize any potential disruptions in service. Additionally, the CSC Team recommends that the last segment not be transitioned until the legacy software conversion from VAX Oracle to MS Access is complete so to eliminate interruptions in data access.

2.2.5 Cable Plant

The existing ARI cable plant consists of thick and thin Ethernet interfaced with DEC proprietary hardware (DELNIs and DEMPRs). Based on network traffic statistics gathered during this study, the cable plant should provide adequate service to ARI HQ into FY97. ARI should plan to replace this with a new cable plant consisting of Level 5 unshielded twisted pair or fiber optic cable within the next two years. At that time, full segmentation of the ARI network can be achieved and network speed can be increased from 10 Mbs to 100 Mbs throughout the network, with routers installed to localize traffic.

2.3 Security

The ARI network does not process classified data, however, it does process sensitive data that must be protected. The ARI HQ selected network operating system, NTAS, provides a full range of security services. NTAS is considered by the industry to be one of the most secure network operating systems currently available. Still, it relies on adherence by all personnel to good security practices, such as protection of passwords and periodic changes to passwords.

Connection to the Internet poses additional security risks, particularly to intrusion from sources outside ARI. ARI has procured and is in the process of installing a firewall, a device that limits external users' access to network resources. This firewall must be thoroughly tested prior to opening the new Internet gateway. Further, firewall logs must be monitored daily to detect attempts to breach the firewall.

2.4 Acquisition

The ARI-selected client-server architecture requires ARI to purchase minimal hardware and software products. The hardware products include servers and routers. The software products include the operating systems required for the servers and the workstations, licensing software, and electronic mail software. Details of the costs for these products are in the cost estimates, section 2.13.

2.4.1 Hardware

Hardware includes any equipment needed to support the selected network configuration. The following paragraphs detail the hardware in terms of File Servers, Print Servers, Other Servers, and Routers.

2.4.1.1 File Server

The file server must be able to support the volume of traffic generated by ARI. The CSC Team recommends that the file server support a dual Pentium CPU with 64 MB memory. It is further recommended that the server provide 10 GB of storage (with two of those GB mirrored), as well as a CD ROM. Finally, the server must come equipped with a 1.44 MB 3.5" disk drive.

2.4.1.2 Print Servers

ARI printers are located throughout the 6th floor of the AMC building in Alexandria, Virginia. They are presently being operated from DEC print servers. These print servers should be replaced with newer print servers that will work with NTAS. The CSC Team recommends JetDrive print servers. These are small (2" x 4" x 6") servers that are multi-protocol compatible, inexpensive at $400 each, and easy to install. One print server will support one printer.

2.4.1.3 Other Servers

The servers that host the other services (i.e., print, mail, database, communications, network management) require a single Pentium CPU with 64 MB memory. The CSC Team recommends that the machines provide 2 GB of storage, as well as a CD ROM. Additionally, the machines must come equipped with a 1.44 MB 3.5" disk drive. It is not necessary to have a dedicated server for each service because one physical machine can provide more than one service. The CSC Team recommends hosting e-mail and network management on one machine, with RAS, FTP Server, and WWW Server on another machine.

2.4.1.4 Routers

Routers are required to reduce the traffic on the ARI network. This is accomplished by containing traffic within the segment through eliminating unnecessarily travel on the network. Routers were selected over bridges since bridges do not support this resource-intensive aspect of networking. Based on network traffic statistics collected on 15 December 1995 and 18 December 1995, acquisition and installation of routers can be delayed until FY97 at the earliest.

2.4.2 Software

Software includes applications as well as operating systems and communication packages that will support ARI's architecture. The following paragraphs detail the Operating Systems, Metering software, and MS Back Office.

2.4.2.1 Operating Systems

Servers and workstations will require operating systems. ARI HQ selected MS NTAS as the network operating system (NOS) for their servers.

2.4.2.2 Metering

To effectively optimize the usage of software applications, ARI requires a software licensing package. This application will reduce the expense of licensing for seldom-used packages and maximize the use of frequently-used packages by users throughout the organization.

2.4.2.3 MS Back Office

MS Back Office is a combination of five different MS tools. They include System Management Server (SMS), SNA Server, SQL NT Server, and MS Mail Server.

2.5 Integration Testing

Integration testing of the ARI HQ network will require no specialized skills, software, or equipment.

2.6 Staffing and Training Issues

2.6.1 Implementation Process

Recommended staffing levels for the implementation process follows:

Supervisor	1
Network Engineer	2
Network Administrator	1
Computer Specialist	2

These levels are in addition to current operations and maintenance personnel.

Training for the above personnel has been scheduled in the implementation plan, to include 4 weeks of training for the network administrator and network engineers respectively, as well as two weeks of training for the computer specialists.

2.6.2 Operations and Maintenance

Staffing for the operations and maintenance after implementation follows:

Supervisor	1
Network Engineer	3
Network Administrator	1
Network Specialist	3

2.7 Cross Functional Integration

Cross functional integration is the term applied to issues or tasks that cross functional areas. The goal of CFI is to examine processes within an area to identify opportunities for cooperation and synergy. For example, personnel and budgeting are closely linked by the nature of their focus and type of work. The CSC Team did not focus on this aspect during the development of the Architecture Implementation Plan because cross functional integration did not impact on the architecture design or implementation.

2.8 Task Dependencies and Schedule

The task dependencies and schedule have been assembled into a Gantt chart. That chart is included as Appendix B.

2.9 Project Management Plan

The project management of the ARI HQ network implementation provides for the overall supervision of the migration task. The plan for the implementation is included as a Gantt chart in Appendix B for easier visibility. This section of the document describes those tasks as outlined in the Gantt chart.

2.9.1 Conducting Detailed Network Engineering

Conducting Detailed Network Engineering includes

- Developing a Network Traffic Profile:

  Using network monitoring software, developing traffic profiles for each user (e.g. average number of bytes of network traffic per hour)

- Defining Segments:

  Based on data from Developing a Network Traffic Profile, assign network users so network traffic is balanced across segments

- Determining Mass Storage Requirements:

  Review mass storage requirements for segment users by interview and review storage used on the VAX to determine total amount of disk space required on each network segment

- Configure Server Profiles:

  Develop profile for each segment file server, identify mass storage requirements and need for dual versus single Pentium file server

2.9.2 Procuring Hardware and Software

Procuring Hardware and Software includes

- o Develop Procurement plan:

  Identify contract vehicle, prepare RFP or Purchase Order

- o Issue RFP and/or Purchase Order:

  (Milestone)

- o Receive Hardware and Software:

  Receive and inspect shipments of hardware/software to ARI HQ

- o Receive Hardware/Software:

  (Milestone)

2.9.3 Train System Engineers, Network Administrators and Computer Specialists

Network Engineers and Network Administrators receive training in configuring, installing and maintaining NTAS and MS Back Office software.

2.9.4 Install Mail Server

Firewall and Internet router must be installed before any mail system can receive mail from remote sites. Administration of new addresses (assignment, publication) must be completed prior to cutover to new mail system. Users must be trained.

2.9.5 Migrate Users on Segment 1 to New Server

- o Install File Server 1:

  As the first server to be installed and cutover, this series of tasks serves as a template for installation of file servers 2 and 3. File server installation includes installation of print servers driven by this file server.

- o Install Licensee Management Software:

  Prior to moving software off the VAX, some means of monitoring software usage to prevent software licensee violations must be installed

- o Install System Management Software:

  SMS is part of MS Back Office. SMS requires MS SQL server to complete configuration.

- Install Tape Back System:

  Required to backup new server and must be configured to initiate backups upon server cutover.

- Migrate Users to File server 1:

  Individual workstations will have to be reconfigured to access the new file server.

2.9.6 Migrate Users on Segment 2 to New Server

Repeat Steps for Segment 1

2.9.7 Migrate Users on Segment 3 to New Server

Repeat Steps for Segment 1

2.9.8 Install Communications Server

Configure server with sufficient serial ports, install software, train users

2.9.9 Install WWW/FTP Server

Install FTP server and WWW Server software on hardware, place server on public access segment.

2.9.10 Install DARS on Network

Connect DARS network to ARI backbone

2.10 Cost Estimates

In determining the cost estimates, the CSC Team referenced GTSI GSA Schedule A (Contract # GS-35F-0131D) and GSA Schedule BC (Contract # GS00K95AGS6407) as sources for product information listed here. Servers were based on Compaq Computers, Inc. models, which represent high-end servers. Numerous other contract vehicles are available. Prices that follow are representative of higher-end prices found on most Government contracts. Table 2.10-1 details the hardware and software estimates.

YEAR 1 Investment Costs

Item	Price	Quantity	Total Price	
Hardware:				
File Servers consisting of:				
Server	$17,172.00	3	$51,516.00	
SCSI Array Controller	$2,138.00	3	$6,414.00	
64 MB Memory	$2,868.00	3	$8,604.00	
10 GB storage	$6,044.00	3	$18,132.00	
UPS	$1,148.00	3	$3,444.00	
Total File Servers			$88,110.00	
Other Servers consisting of:				
Server	$12,420.00	3	$37,260.00	
64 MB Memory	included	3	$0.00	
2GB storage	$1,079.00	3	$3,237.00	
16 port Digiboard	$1,100.00	2	$2,200.00	
UPS	$719.00	3	$2,157.00	
Print Servers	$400.00	17	$6,800.00	
Total Other Servers			$51,654.00	
Backup:				
Juke Box Back up System	$5,890.00	1	$5,890.00	
Back up software	$2,000.00	1	$2,000.00	
Total Backup			$7,890.00	
Total Hardware:			**$147,654.00**	
Software:				
Operating Systems:				
WIndows NT	$269	5	$1,345.00	
Windows 95 upgrade	$89	190	$16,910.00	
WIndows 95 complete	$179	10	$1,790.00	
Total Operating Systems			$20,045.00	
Metering Software				
Client License	$20	200	$4,000.00	
Total Metering Software			$4,000.00	
MS BackOffice				
BackOffice	$2,129	1	$2,129.00	
BackOffice client licenses	$259	4	$1,036.00	
NTAS Server licenses	$579	5	$2,895.00	
NTAS client licenses	$20	195	$3,900.00	
MS Mail Clients	$50	195	$9,750.00	
Total MS BackOffice			$19,710.00	
Total Software:			**$43,755.00**	
Training*				
Network Engineer Training	$1,200	8	$9,600.00	
Network Admin Training	$1,200	4	$4,800.00	
Computer Specialist Tng	$1,200	4	$4,800.00	
(*Quantity is in weeks)				
Total Training:			**$19,200.00**	
Grand Total Year 1				**$210,609.00**

YEAR 2 Investment Costs

Item	Price	Quantity	Total Price	
Routers	$5,000	3	$15,000.00	
Cable Plant (labor + material)	$200	150	$30,000.00	
Network Interface Cards	$200	150	$30,000.00	
Grand Total Year 2				**$75,000.00**

2.10.1 Hardware

Hardware includes any equipment needed to support the selected network configuration. The following paragraphs detail File Server, Other Servers, Routers, and Other Hardware Costs.

2.10.1.1 File Server

A Compaq file server priced by the CSC Team totaled $17,172. A SCSI array controller priced at $2,138 is required to use the dual Pentium. The 64 MB of RAM required by the Pentium was priced at $2,868. The cost of 10 GB of mass storage totaled $6,044. An Uninterruptable Power Supply (UPS) added $1,148 to the price of the file server, but provides guaranteed service from that server. Therefore, the CSC Team estimates the total cost of a file server to be $29,370, thus, the cost for three file servers would total $88,110.

2.10.1.2 Other Servers

The other file servers needed by the ARI network were base-priced at $12,420. Additionally, the cost of 2 GB of mass storage totaled $1,079. An Uninterruptable Power Supply (UPS) adds $719 to the cost of the server, but provides guaranteed service. Thus, the CSC Team estimates each server to total $14,218. In addition, two 16 port digiboards will be required for the remote access server, at a cost of $1,100 each, to support a modem pool of 32 modems.

2.10.1.3 Routers

CICSO 7000 routers cost approximately $5,000 each. Three routers are required for the selected ARI HQ configuration. The cost for three routers totals $15,000. Acquisition of the routers can be delayed for at least one year, based on expected network traffic in the first year.

2.10.1.4 Hardware

The CSC Team recommends that ARI purchase a tape-backup jukebox, along with the appropriate software to enable the network staff to effectively perform backups. The estimated cost of the jukebox is $5,890 for hardware and $2,000 for backup software.

2.10.2 Software

Software includes applications, as well as operating systems and communication packages that support the selected architecture. The following paragraphs detail Operating Systems, Metering software, and MS Back Office costs.

2.10.2.1 Operating Systems

There are several options, depending on the current state of flux in the organization:

Server: Windows NT (required for the multiple servers) will cost approximately $269 per server.

Client (workstations): Windows 95 operating system installation costs about $179 per workstation. This software is distributed on 3.5" diskettes. If the workstation is already using Windows 3.1, then only an upgrade to Windows 95 is required. The upgrade sells for about $89. The upgrade is distributed on CD-ROM.

2.10.2.2 Metering

Licenses for Centameter average less than $20 per user. No additional base cost is required for Centameter; all costs are based on the number of user licenses required.

2.10.2.3 MS Back Office

MS Back Office sells for about $2,129. Client Licenses for MS Back Office are $259. ARI will require five client licenses of Back Office for a total of $1,295. The selected architecture will require four additional licenses for NT Server (part of Back Office) at a cost of $579 per license, for a total of $2,316. Each workstation will also require access to NT Server for remote access for a total workstation cost of $5,111. In order to provide MS Mail access to all personnel, an additional 195 client licenses for MS Mail will cost $11,976.

2.10.3 Labor Costs to Implement

An annual labor cost of $50,000 per person was used to estimate Phase 1 labor costs of $175,000. Using the same estimate, estimated annual labor costs for operations and maintenance of the recommended ARI Information System is $400,000.

2.10.4 Operations and Maintenance Costs After Implementation

The following tables compare estimated operating costs for the recommended architecture with current costs for operating ARI's existing architecture. Existing cost estimates were provided by ARI Contracting Officer's Technical Representative and are based on $50,000 per year per Government employee.

Table 2.10.4-1 Approximate Annual Cost of Operating and Maintaining Current VAX System

Item	Qty	Total Cost
VAX Facility Management		
Government Personnel	2	$100,000
Contractor Personnel	4	*
VAX Hardware Maintenance		$68,000
Annual VAX Software Licenses Renewal		$161,000
Computer & LAN Specialists		
Government Personnel	6	$300,000
Contractor Personnel	4	*
Total Personnel	16	
Contractor Costs (*)		300,000
Total Ops & Maint Costs		**$929,000**

Table 2.10.4-2 Estimated Annual Cost of Operating and Maintaining Proposed Information System and Infrastructure

Personnel	Grade	Qty	*Cost	Total
Supervisor	14	1	$69,041	$69,041
Sr Network Engineer	13	1	58,424	58,424
Network Engineer	12	2	49,132	98,264
Network Administrator	12	1	49,132	49,132
Sr Computer Specialist	12	1	49,132	49,132
Computer Specialist	11	2	37,691	75,382
Total Personnel Costs		8		$399,375
Hardware and Software Maintenance				$31,500
Annual Software License Renewal				*
Grand Total Ops & Maint				**$430,875**
			*Step 5 average	

Based on these estimates, the operations and maintenance cost of the proposed system is estimated to be less than one half that of the present system ($929,000 vs $431,000). Fully burdened, the cost saving is close to $1,000,000.

2.11 Technical Risks and Risk Management Plan

2.11.1 Cable Plant

The greatest technical risk associated with this migration plan is the failure of the existing ARI cable plant to support the proposed network architecture. The existing cable plant consists of thick and thin coaxial cable Ethernet, DEC proprietary multiport repeaters, and cable interface units. The DEC hardware may prove problematical when routers are installed to isolate local traffic to each network segment.

To minimize this risk, the CSC Team recommends the following actions:

- Replace the existing cable plant (both thick and thin coaxial cables) with Level 5 twisted pair cable. Level 5 twisted pair cable will provide up to 100 Mbs speeds and should be adequate for a minimum of five years.

- Plan for a cable plant upgrade within the next two years. Based on ARI-specified requirements along with measurements of network activity taken by the CSC Team, this timeframe is sufficient and will not adversely impact the performance.

2.11.2 Network Management

The other technical risk is associated with network management. As indicated in the ARI Information Systems Architecture Report, the proposed network architecture consisting of multiple file, print, communications, and mail servers requires different network management skills than the present ARI network.

To minimize this risk, the CSC Team recommends the following actions:

- Network personnel must be trained to configure and maintain the network, as well as provide necessary user assistance, especially during the transition from the existing network operating system to NTAS.

- Network management tools must be purchased and installed early to assist in managing this network. They are specified in the paragraphs above.

2.12 Tools

No specialized tools are foreseen as required for the implementation of the chosen architecture at ARI HQ.

2.13 TAFIM Compliance

The Technical Architecture Framework for Information Management (TAFIM) provides guidance for the evolution of the DoD Technical Infrastructure. It provides the services, standards, design concepts, components, and configurations that can be used to guide the development of technical architectures that meet specific mission requirements.

The CSC Team has evaluated the eight objectives of the TAFIM against the selected architecture to determine the TAFIM compliance. The table 2.13-1 depicts the TAFIM objectives.

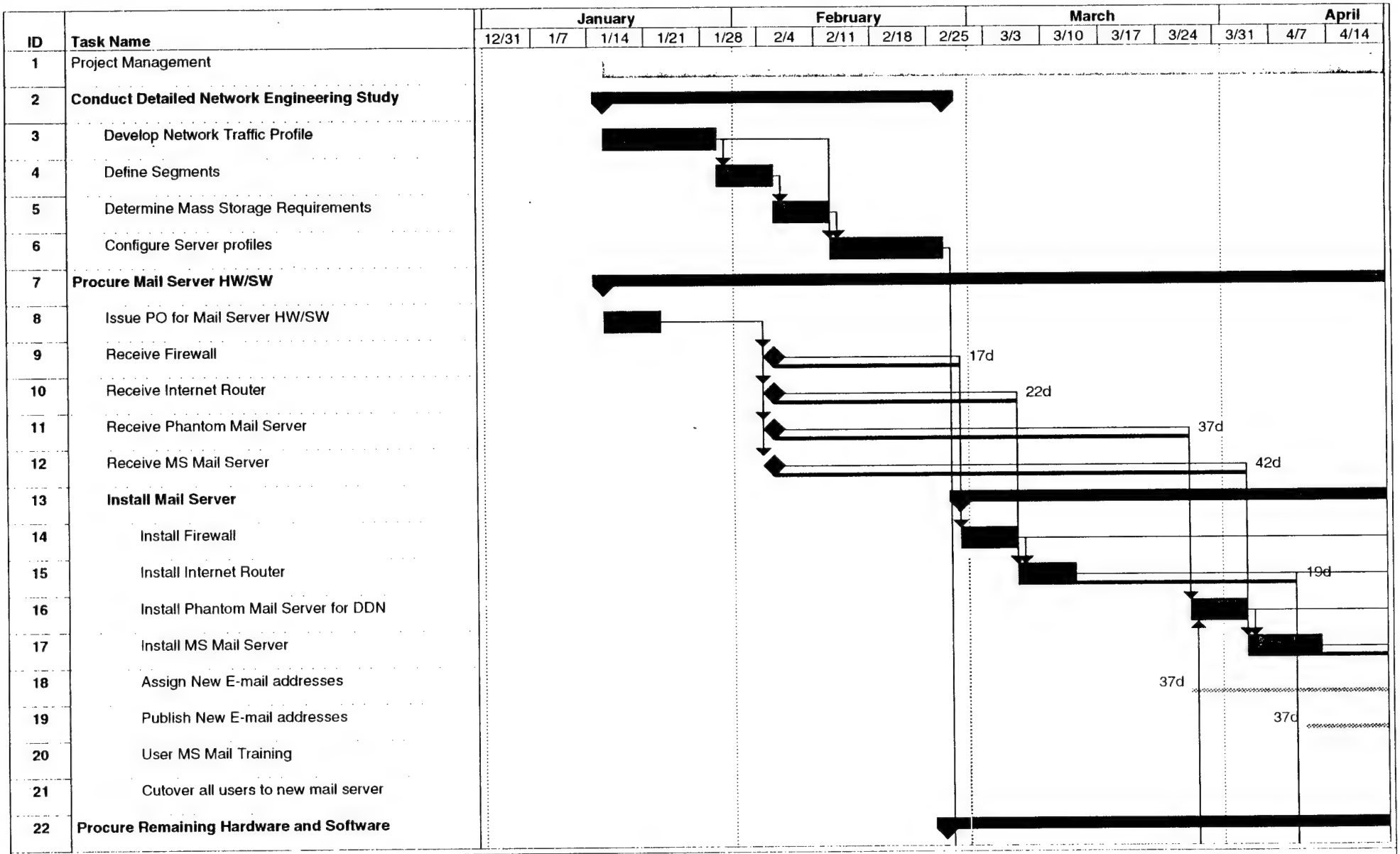
Table 2.13-1 TAFIM Objectives

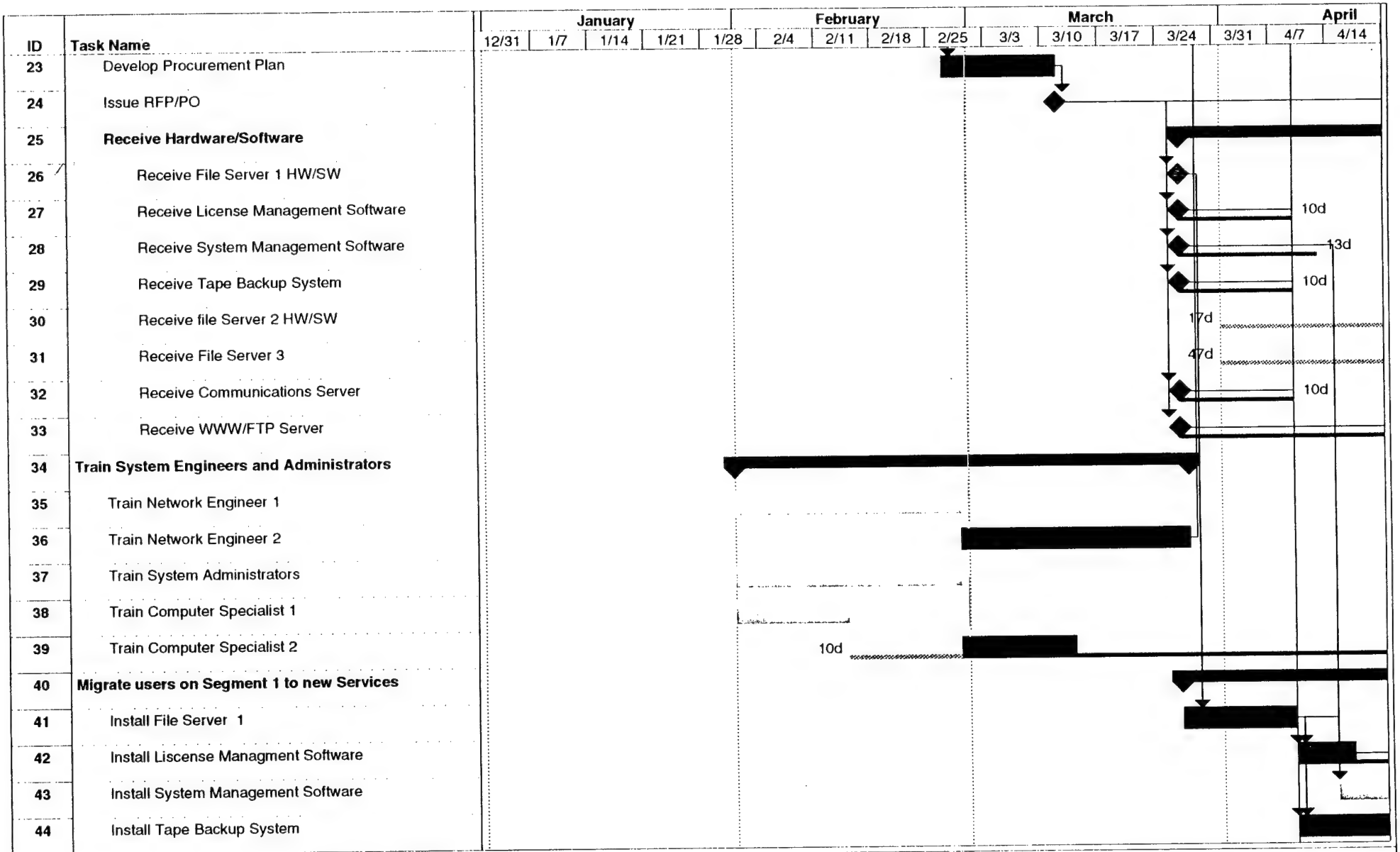
Objective	Architecture Design	Assessment
Improve User Productivity		
Consistent User Interface	Windows	
Integrated Applications	MS Office & Mail	
Data Sharing	File Sharing	
Improve Development Efficiency		
Common Development		NA
Common Open System Environment	Windows GUI	
Use of Commercial Products	Windows/NTAS	
Software Reuse		NA
Resource Sharing	Shared Peripherals, Files	
Improve Portability and Stability		
Portability	Windows	
Scalability	SMP/Multi Server	
Improve Interoperability		
Common Infrastructure		
Standardization		
Promote Vendor Independence		
Interchangeable Components		
Non-Propriety Specifications	MS Windows	
Reduce Life Cycle Costs		
Reduce Duplication		
Reduce Software Maintenance Costs		
Reduce Training Costs		
Improve Security Policy		
Uniform Security Accreditation		NA
Consistent Security Interfaces		NA
Different Domain Processing		NA
Distributed Systems Processing		NA
Support of Common Communications	Fire Wall	
Improve Manageability		
Consistent Management Interface	Sys Mgmt Server (SMS)	
Management Standardization		NA
Reduced Opns, Admin, and Maint Costs		NA
Legend:		Good Average

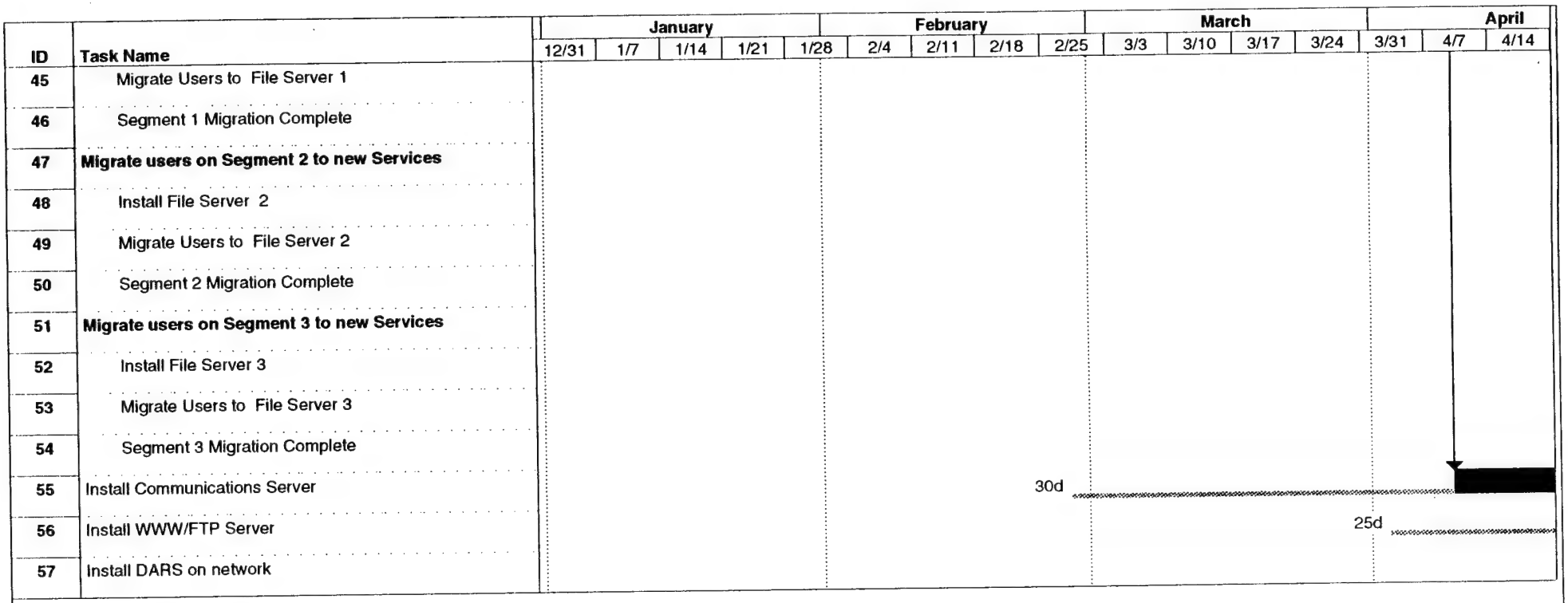
Appendix A
List of Acronyms

ARI	Army Research Institute
CPU	Central Processing Unit
DEC	Digital Equipment Corporation
GB	Gigabytes
GSA	General Services Administration
Mbs	Megabits per second
MB	Megabytes
MS	Microsoft
NOS	Network Operating System
NTAS	New Technology Advanced Server
SMS	System Management Service
SNA	System Network Architecture
SQL	Structured Query Language
SCSI	Small Computer Systems Interface
TAFIM	Technical Architecture Framework for Information Management

Appendix B
Task Dependencies and Schedules

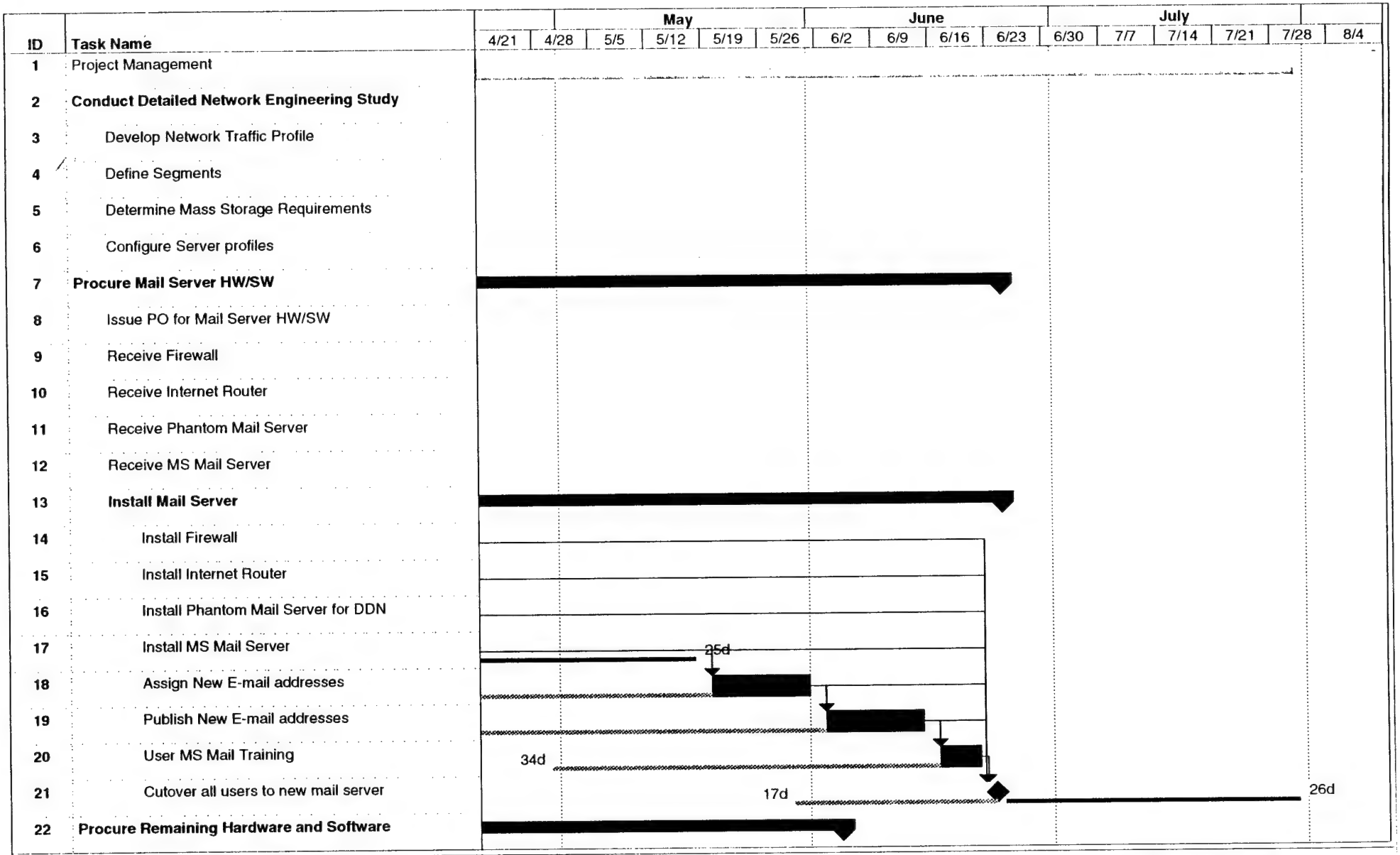

January
February
March
April
12/31
1/7
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/3
3/10
3/17
3/24
3/31
4/7
4/14
ID
Task Name
1 Project Management
2 Conduct Detailed Network Engineering Study
3 Develop Network Traffic Profile
4 Define Segments
5 Determine Mass Storage Requirements
6 Configure Server profiles
7 Procure Mail Server HW/SW
8 Issue PO for Mail Server HW/SW
9 Receive Firewall
10 Receive Internet Router
11 Receive Phantom Mail Server
12 Receive MS Mail Server
13 Install Mail Server
14 Install Firewall
15 Install Internet Router
16 Install Phantom Mail Server for DDN
17 Install MS Mail Server
18 Assign New E-mail addresses
19 Publish New E-mail addresses
20 User MS Mail Training
21 Cutover all users to new mail server
22 Procure Remaining Hardware and Software
17d
22d
37d
42d
19d
37d
37d
Project: ARI Information Systems Migr.
Date: 12/26/95
Critical Task
Task
Progress
Milestone
Slack
Slippage
Summary
Rolled Up Critical Task
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress


ID
Task Name
January
February
March
April
12/31
1/7
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/3
3/10
3/17
3/24
3/31
4/7
4/14
23 Develop Procurement Plan
24 Issue RFP/PO
25 Receive Hardware/Software
26 Receive File Server 1 HW/SW
27 Receive License Management Software
28 Receive System Management Software
29 Receive Tape Backup System
30 Receive file Server 2 HW/SW
31 Receive File Server 3
32 Receive Communications Server
33 Receive WWW/FTP Server
34 Train System Engineers and Administrators
35 Train Network Engineer 1
36 Train Network Engineer 2
37 Train System Administrators
38 Train Computer Specialist 1
39 Train Computer Specialist 2
40 Migrate users on Segment 1 to new Services
41 Install File Server 1
42 Install Liscense Managment Software
43 Install System Management Software
44 Install Tape Backup System
10d
13d
10d
17d
47d
10d
10d
Project: ARI Information Systems Migr.
Date: 12/26/95
Critical Task
Task
Progress
Milestone
Slack
Slippage
Summary
Rolled Up Critical Task
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress



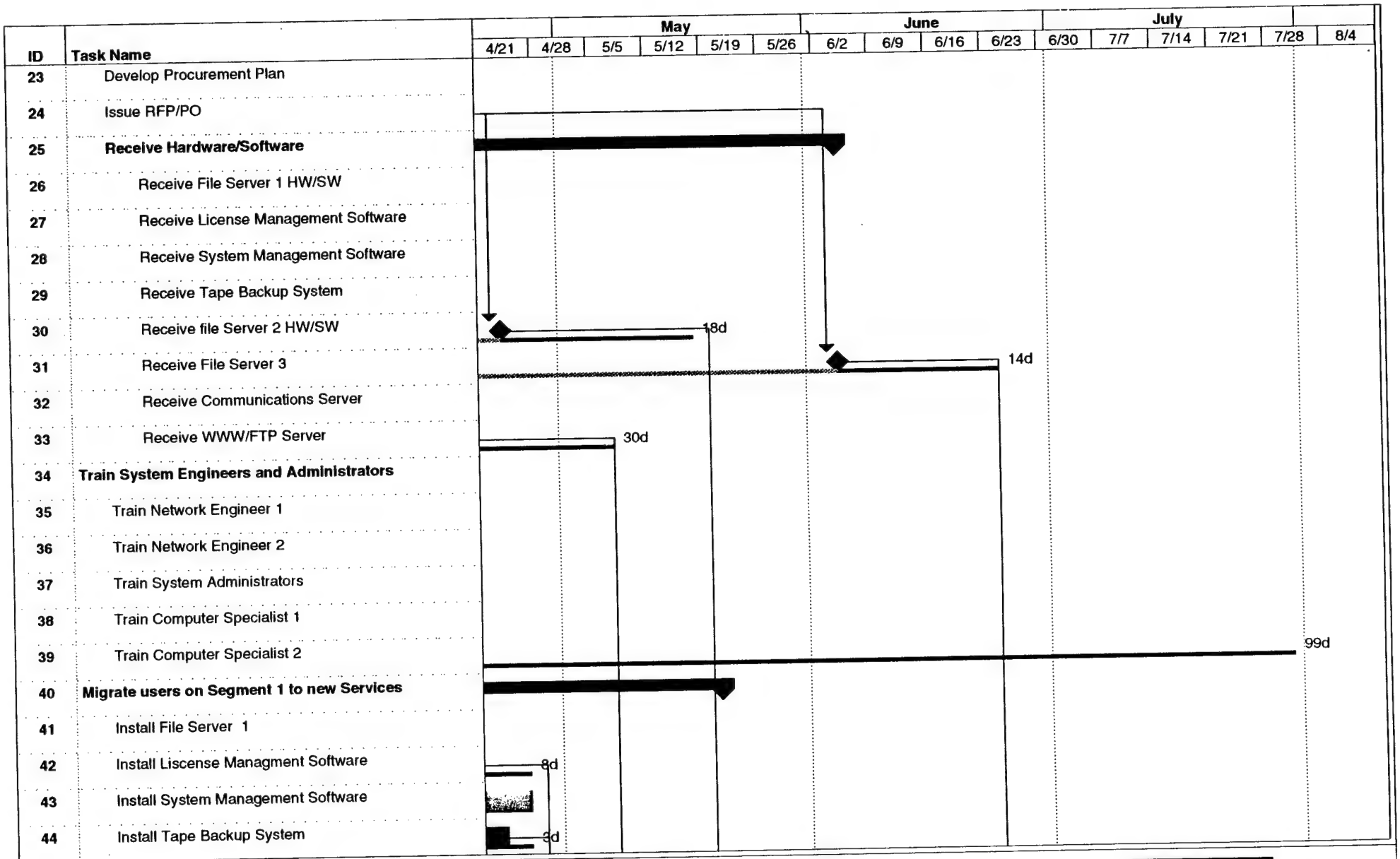
Project: ARI Information Systems Migr.
Date: 12/26/95

Critical Task
Task
Progress
Milestone
Slack
Slippage
Summary
Rolled Up Critical Task
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress



Project: ARI Information Systems Migr.
Date: 12/26/95

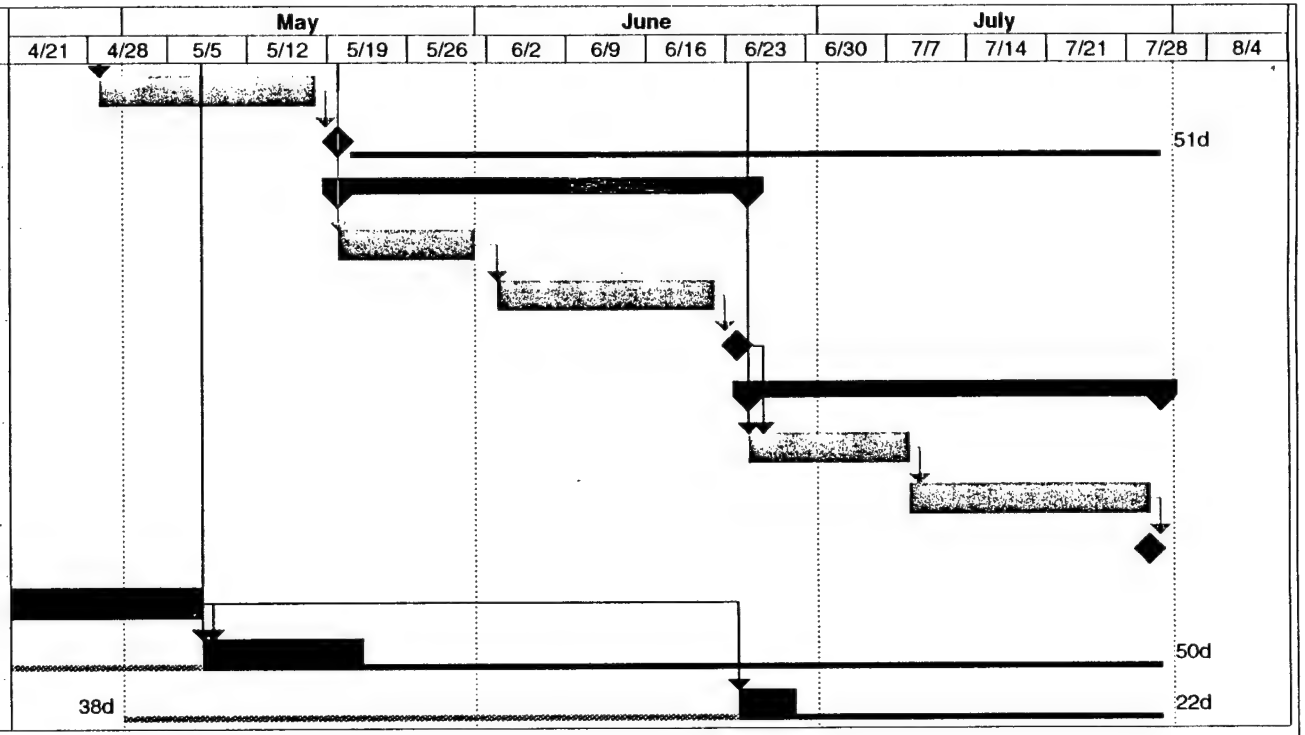
Critical Task
Task
Progress
Milestone
Slack
Slippage
Summary
Rolled Up Critical Task
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress



Project: ARI Information Systems Migr.
Date: 12/26/95

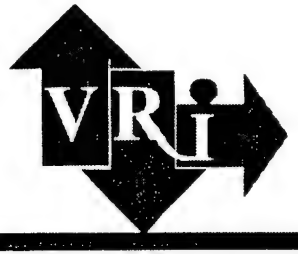
Critical Task
Task
Progress
Milestone
Slack
Slippage
Summary
Rolled Up Critical Task
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

ID	Task Name
45	Migrate Users to File Server 1
46	Segment 1 Migration Complete
47	**Migrate users on Segment 2 to new Services**
48	Install File Server 2
49	Migrate Users to File Server 2
50	Segment 2 Migration Complete
51	**Migrate users on Segment 3 to new Services**
52	Install File Server 3
53	Migrate Users to File Server 3
54	Segment 3 Migration Complete
55	Install Communications Server
56	Install WWW/FTP Server
57	Install DARS on network



Project: ARI Information Systems Migr.
Date: 12/26/95

Critical Task
Task
Progress
Milestone
Slack
Slippage
Summary
Rolled Up Critical Task
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress



ARI Enterprise Information Systems Architecture and Strategic Plan Support

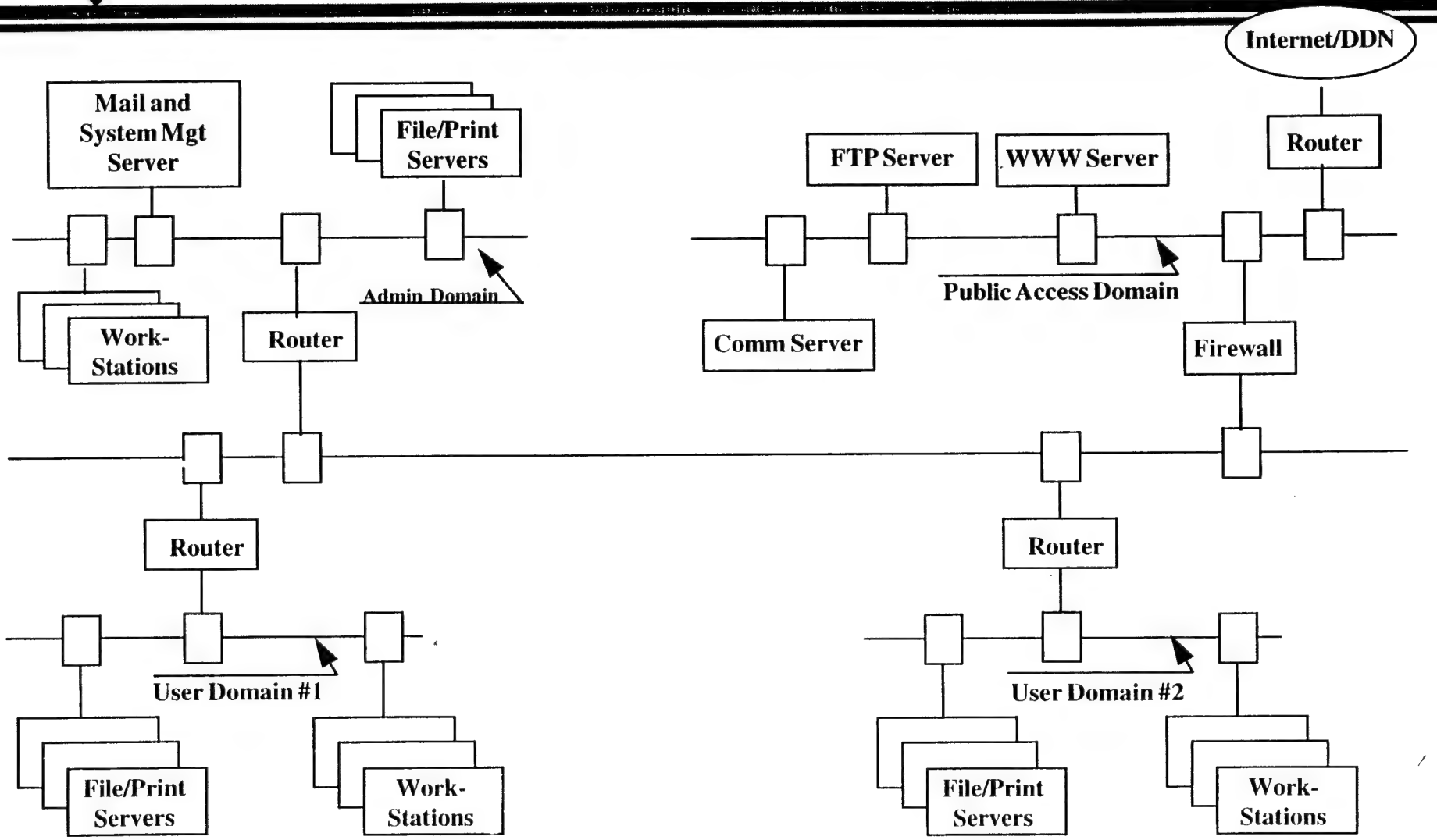
Implementation Plan

21 December 1995

Introduction

- Based on ARI current requirements and capabilities
- Complies with DoD Technical Architecture Framework
- Architecture consists of:
  - » Computing Platforms
  - » Communication Networks
  - » Applications

Network Topology: Segmented Network



Investment - Year 1 (H/W)

YEAR 1 Hardware Investment Costs			
Item	Price	Quantity	Total Price
File Servers consisting of:			
Server	17,172	3	$51,516
SCSI Array Controller	2,138	3	$6,414
64 MB Memory	2,868	3	$8,604
10 GB storage	6,044	3	$18,132
UPS	1,148	3	$3,444
Total File Servers			$88,110
Other Servers consisting of:			
Server	12,420	3	$37,260
64 MB Memory	included	3	$0
2GB storage	1,079	3	$3,237
16 port Digiboard	1,100	2	$2,200
UPS	719	3	$2,157
Total Other Servers			$44,854
Backup:			
Juke Box Back up	5,890	1	$5,890
Back up software	2,000	1	$2,000
Total Backup			$7,890
Total Hardware:			**$140,854**

Investment - Year 1 (S/W)

YEAR 1 Software Investment Costs				
Item	**Price**	**Quantity**	**Total Price**	
Operating Systems:				
WIndows NT	269	5	$1,345	
Windows 95 upgrade	89	190	$16,910	
WIndows 95 complete	179	10	$1,790	
Total Operating Systems			$20,045	
Metering Software				
Client License	20	200	$4,000	
Total Metering Software			$4,000	
MS BackOffice				
BackOffice	2129	1	$2,129	
BackOffice client licenses	259	4	$1,036	
NTAS Server licenses	579	4	$2,316	
NTAS client licenses	549	20	$10,980	
MS Mail Clients	899	20	$17,980	
Total MS BackOffice			$34,441	
Total Software:			**$58,486**	
Grand Total Year 1				**$199,340**

Investment - Year 2

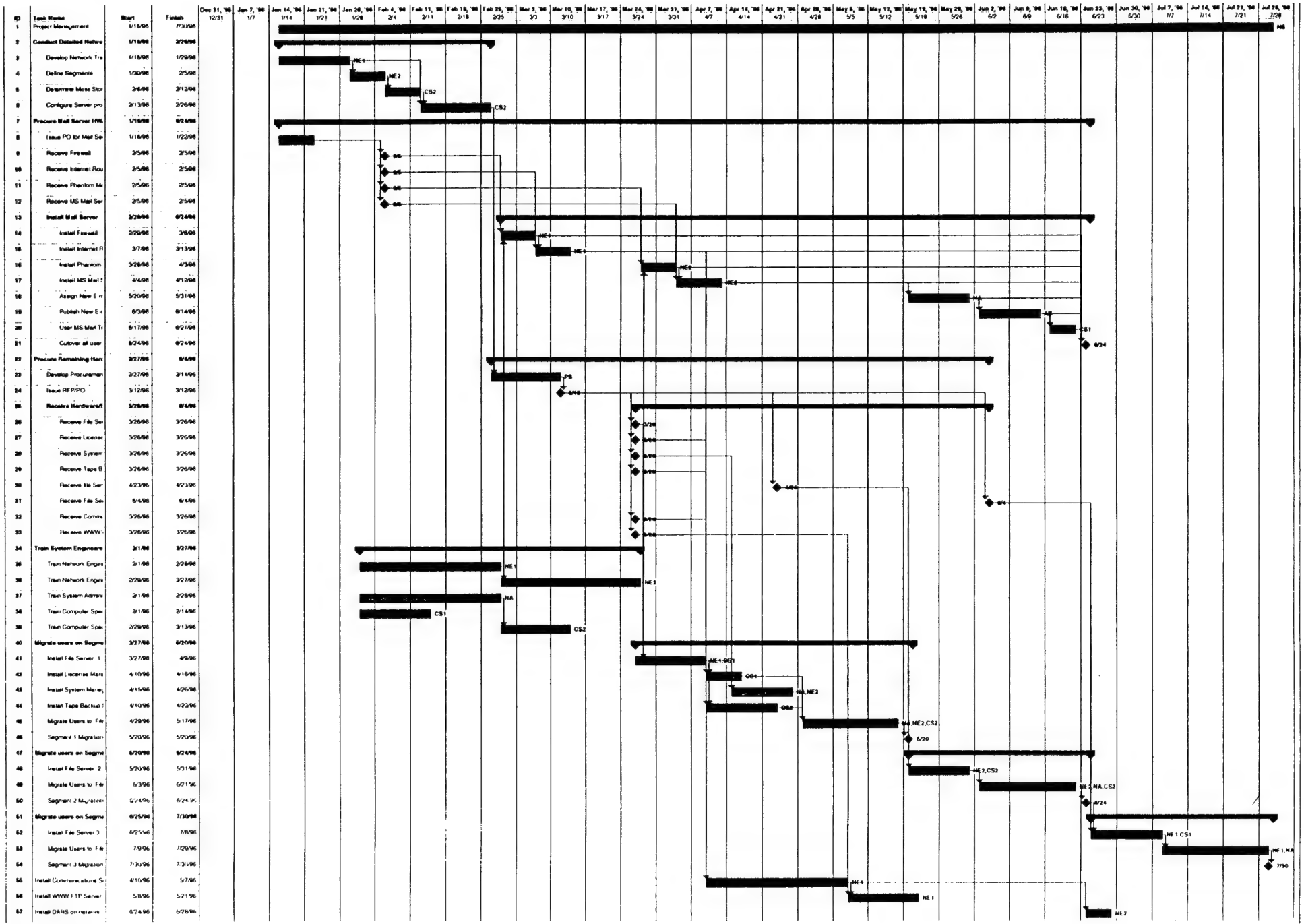
YEAR 2 Investment Costs				
Item	**Price**	**Quantity**	**Total Price**	
Routers	5000	3	$15,000	
Cable Plant	200	150	$30,000	
Network Interface Cards	200	150	$30,000	
Grand Total Year 2				**$75,000**

Implementation Plan

- Assumptions
  - » Use In-house resources
  - » Use Existing Cable Plant for 1st Year
- Train Implementation Team
- Install Mail Server
- Install File Servers
- Install Other Servers
- Pull Switch on VAX

Ops and Maintenance Team

- Supervisor (1)
- *Network Engineer* (3)
- Network Administrator (1)
- *Computer Specialist* (3)

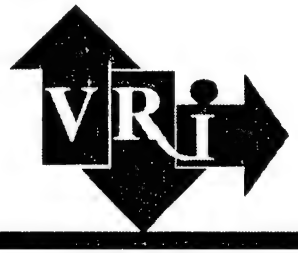

ID
Task Name
Start
Finish
Project Management 1/16/96 7/30/96
Conduct Detailed Netwo 1/16/96 2/26/96
Develop Network Tra 1/16/96 1/29/96
Define Segments 1/30/96 2/5/96
Determine Mass Stor 2/6/96 2/12/96
Configure Server pro 2/13/96 2/26/96
Procure Mail Server HW 1/16/96 6/24/96
Issue PO for Mail Se 1/16/96 1/22/96
Receive Firewall 2/5/96 2/5/96
Receive Internet Rou 2/5/96 2/5/96
Receive Phantom Mi 2/5/96 2/5/96
Receive MS Mail Ser 2/5/96 2/5/96
Install Mail Server 2/26/96 6/24/96
Install Firewall 2/26/96 3/6/96
Install Internet R 3/7/96 3/13/96
Install Phantom 3/28/96 4/3/96
Install MS Mail S 4/4/96 4/12/96
Assign New E-m 5/20/96 5/31/96
Publish New E-r 6/3/96 6/14/96
User MS Mail Tr 6/17/96 6/21/96
Cutover all user 6/24/96 6/24/96
Procure Remaining Hard 2/27/96 6/4/96
Develop Procuremen 2/27/96 3/11/96
Issue RFP/PO 3/12/96 3/12/96
Receive Hardware/S 3/26/96 6/4/96
Receive File Se 3/26/96 3/26/96
Receive License 3/26/96 3/26/96
Receive System 3/26/96 3/26/96
Receive Tape B 3/26/96 3/26/96
Receive Ite Ser 4/23/96 4/23/96
Receive File Se 6/4/96 6/4/96
Receive Comm 3/26/96 3/26/96
Receive WWW 3/26/96 3/26/96
Train System Engineers 2/1/96 3/27/96
Train Network Engin 2/1/96 2/28/96
Train Network Engin 2/29/96 3/27/96
Train System Admin 2/1/96 2/28/96
Train Computer Spe 2/1/96 2/14/96
Train Computer Spe 2/29/96 3/13/96
Migrate users on Segme 3/27/96 6/20/96
Install File Server 1 3/27/96 4/9/96
Install License Mar 4/10/96 4/16/96
Install System Mana 4/15/96 4/26/96
Install Tape Backup 4/10/96 4/23/96
Migrate Users to File 4/29/96 5/17/96
Segment 1 Migration 5/20/96 5/20/96
Migrate users on Segme 5/20/96 6/24/96
Install File Server 2 5/20/96 5/31/96
Migrate Users to File 6/3/96 6/21/96
Segment 2 Migration 6/24/96 6/24/96
Migrate users on Segme 6/25/96 7/30/96
Install File Server 3 6/25/96 7/8/96
Migrate Users to File 7/9/96 7/29/96
Segment 3 Migration 7/30/96 7/30/96
Install Communications Se 4/10/96 5/7/96
Install WWW FTP Server 5/8/96 5/21/96
Install DARS on network 6/24/96 6/28/96
Dec 31, '95 12/31
Jan 7, '96 1/7
Jan 14, '96 1/14
Jan 21, '96 1/21
Jan 28, '96 1/28
Feb 4, '96 2/4
Feb 11, '96 2/11
Feb 18, '96 2/18
Feb 25, '96 2/25
Mar 3, '96 3/3
Mar 10, '96 3/10
Mar 17, '96 3/17
Mar 24, '96 3/24
Mar 31, '96 3/31
Apr 7, '96 4/7
Apr 14, '96 4/14
Apr 21, '96 4/21
Apr 28, '96 4/28
May 5, '96 5/5
May 12, '96 5/12
May 19, '96 5/19
May 26, '96 5/26
Jun 2, '96 6/2
Jun 9, '96 6/9
Jun 16, '96 6/16
Jun 23, '96 6/23
Jun 30, '96 6/30
Jul 7, '96 7/7
Jul 14, '96 7/14
Jul 21, '96 7/21
Jul 28, '96 7/28
Project: ARI Information Systems Migration
Date: 12/21/95
Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress
Page 1

Task Schedule Overview

Task Name	Start	Finish
Network Engineering Study	1-16-96	2-26-96
Procure Hardware and Software	1-16-96	6-24-96
Train System Enginerrs and Administrators	2-01-96	3-27-96
Install Mail Server	2-29-96	6-24-96
Migrate Users - Segment 1	3-27-96	5-20-96
Migrate Users - Segment 2	5-20-96	6-24-96
Migrate Users - Segment 3	6-25-96	7-30-96
Install Other Servers	4-10-96	6-28-96

Network Engineering

Task Name	Duration	Resource
Conduct Detailed Network Engineering Study	*30 days*	
Develop Network Traffic Profile	2 weeks	Net Engr
Define Segments	1 week	Net Engr
Determine Mass Storage	1 week	Comp Spec



Procure H/W and S/W

Task Name	Duration	Resource
Procure Hardware and Software	*25 days*	
Develop Procurement Plan	2 weeks	Proc Spec
Issue RFP/PO	1 day	
Receive Hardware/Software	*1 day*	
Firewall	1 day	
Internet Router	1 day	
Phantom Mail Server	1 day	
MS Mail Server	1 day	
File Server 1	1 day	
License Management Software	1 day	
System Management Software	1 day	
Tape Backup System	1 day	
File Server 2	1 day	
File Server 3	1 day	
Communications Server	1 day	
WWW/FTP Server	1 day	

Train Network Staff

Task Name	Duration	Resource
Train System Engineers and Administrators	*40 days*	
Train Network Engineer #1	4 weeks	Net Eng #1
Train Network Engineer #2	4 weeks	Net Eng #2
Train System Administrators	4 weeks	
Train Computer Specialist #1	2 weeks	Comp Spec #1
Train Computer Specialist #2	2 weeks	Comp Spec #2
All Information Systems Personnel Trained	1 day	

Install Mail Server

Task Name	Duration	Resource
Install Mail Server	*46 days*	
Install Firewall	1 week	Net Eng 1
Install Internet Router	1 week	Net Eng 1
Install Phantom Mail Server for DDN	1 week	Net Eng 2
Install MS Mail Server	1 week	Net Eng 2
Assign New E-mail addresses	2 weeks	Net Admin
Publish New E-mail addresses	2 weeks	Admin Spec
User MS Mail Training	1 week	Comp Spec 1
Cutover all users to new mail server	1 day	

Migrate Users - Segment 1

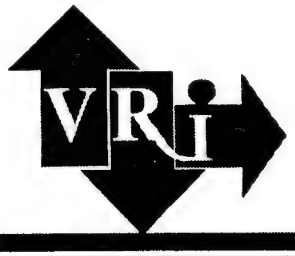
Task Name	Duration	Resource
Migrate Users on Segment 1 to New Services	*38 days*	
Install File Server 1	2 weeks	Net Engr Comp Spec
Install License Management Software	1 weeks	Comp Spec
Install System Management Software	2 weeks	Net Engr Net Admin
Install Tape Backup System	2 weeks	Comp Spec
Migrate Users to File Server 1	3 weeks	Net Admin Net Engr Comp Spec
Segment 1 Migration Complete	1 day	

Migrate Users - Segment 2

Task Name	Duration	Resource
Migrate Users on Segment 2 to New Services	*26 days*	
Install File Server 2	2 weeks	Net Engr Comp Spec
Migrate Users to File Server 2	3 weeks	Net Engr Net Admin Comp Spec
Segment 2 Migration Complete	1 day	

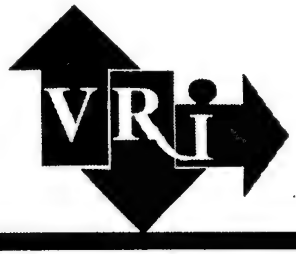
Migrate Users - Segment 3

Task Name	Duration	Resource
Migrate Users on Segment 3 to New Services	*26 days*	
Install File Server 3	2 weeks	Net Engr Comp Spec
Migrate Users to File Server 3	3 weeks	Net Engr Net Admin Comp Spec
Segment 3 Migration Complete	1 day	



Issues

- Training
- Cabling



Summary

- Hardware/Software Investment
  - » Year 1 $200,000
  - » Year 2 $ 75,000
- Complete Migration from VAX by
  - » 1 August 1995
- Improved Mail, File, Print and Remote Access services

ARI's Enterprise Information Systems Architecture and Strategic Plan Support

ARI Enterprise Architecture Report

November 27, 1995

Prepared for:

U.S. Army Information Systems Command - Army Research Institute
ATTN: Mr. Nathaniel Speight
5001 Eisenhower Avenue
Alexandria, VA 22333-5600

Contract Number: DCA100-94-D-0014
Delivery Order Number: 171
CDRL Number: A005

Prepared by:

Computer Sciences Corporation
Defense Enterprise Integration Services
Four Skyline Place
5113 Leesburg Pike, Suite 700
Falls Church, VA 22041

THIS DOCUMENT IS UNCLASSIFIED

TABLE OF CONTENTS

TABLE OF CONTENTS (Contd)

List of Figures

List of Tables

List of Appendices

SECTION 1

1.1 Introduction

The purpose of this document is to describe alternative information systems architecture components and a proposed Army Research Institute (ARI) Enterprise Information Systems Architecture. This document describes the ARI Enterprise Information Systems Architecture in terms of its computing, networking, and communications components. Additionally, this document discusses alternatives for each component and describes the recommended ARI Enterprise Information Systems Architecture in terms of these components.

1.2 Executive Summary

Based on data gathered during the survey of ARI's information system capabilities and requirements, ARI's Enterprise Information System requirements can be best met with a client/server network consisting of Intel architecture-based Personal Computer (PC) workstations. These workstations need to be running some version of Microsoft Windows, preferably Windows 95 or Windows New Technology (NT) and Intel architecture based servers providing file, print, mail, database, communications, and systems management services. A segmented network topology is recommended by the CSC Team to allow for localization of traffic to individual segments. Thus, as network traffic increases it is not propagated throughout the entire network.

1.3 Conclusions

The CSC Team recommends that ARI adopt an Enterprise Information Systems Architecture with the following characteristics/attributes:

- Intel architecture-based PC workstations (486/33 CPU Minimum)
- Windows 95 or Windows NT workstation operating system
- Microsoft (MS) Office suite workstation software
- Segmented network topology
- TCP/IP native Local Area Network (LAN) protocol
- Windows NT Advanced Server (NTAS) network operating system for file and print services
- MS Mail e-mail software
- Windows NT Remote Access Server based communications server
- Windows NT System Management Server for network management
- Wide bandwidth access to the Internet and Defense Information Support Network (DISN) / Defense Data Network (DDN)

ARI's existing network provides a convenient migration path to a segmented network with multiple servers.

SECTION 2

2.1 Computing

This section comprises the conceptual design for the computing component of the ARI Enterprise Information Systems Architecture. Contained herein is a description of the kinds of technologies, referred to as platforms, that will support the ARI business processes within a shared data environment. The ARI technology platforms provide the means for collecting, transporting, storing and processing data, as well as delivering information to customers. Technology platforms are the pipelines and physical facilities of a data utility.

A design for future information systems architecture must take "state-of-the- art" technologies into account and capitalize on current trends being taken advantage of by industry leaders. This is essential if ARI is to satisfy its future information systems requirements through the year 2001. However, it is also ARI-HQ's desire to refrain from overextending themselves in unproven technology. Therefore, key technical principles and platforms have been identified:

- Client/server technology will be used for applications and database implementation.
- Apply open-systems concepts.
- Operating systems must be:
  - ◊ Portable: run across multiple vendor platforms
  - ◊ Scaleable: run across a wide processor range from small to large computers
  - ◊ Interoperable: run in a heterogeneous environment
  - ◊ Compatible: preserve the investment in existing software and enable technology advances to be integrated with other components
- Maintain the security of data, software, and hardware assets at all levels of the technology architecture, while maintaining transparency.
- Ensure recoverability to protect the continuation of business information processes by having:
  - ◊ Adequate and appropriate backups of all data
  - ◊ Software with built-in error checking and recovery capabilities
  - ◊ Integration and compatibility of hardware with redundancies for critical operations

The technology areas and platforms are addressed within the computing architecture of Desktop Workstations, Mainframe Connectivity, Printing, Specialized Hardware/Software, and License Management.

2.1.1 Desktop

All user workstations must have minimum processing capabilities equivalent to a 486/33 PC. The advantage of widespread 486/33 usage is that the workforce will have uniform compatibility and capability. Users will need the speed and power attributes of the 486/33 processors in order to effectively operate the organization's standard software applications. The additional speed and power will allow for future growth as trends show that software applications will only increase in size and complexity. Several key personnel will require a Pentium-class machine due to their data requirements.

All users must have a CD-ROM capability because of the trend to utilize Compact Disks (CD) for database storage and software distribution. Software documentation is being distributed on CDs in order to reduce the printing costs. Users without CD-ROM capability will be hindered in their ability to troubleshoot software or access databases.

The ARI computing architecture must integrate desktop or an open systems-based client /server environment with the older, still valuable, mainframe computing environment. Desktop workstations must have the capability to download, process, and store information obtained from mainframe computers.

ARI must capitalize on the emerging groupware trend. Groupware is a collaborative technology that impacts the way people communicate with each other. The trend is strong for groupware use, fueled by ever increasing networking capabilities. Desktop Video TeleConferencing (DVTC) is one groupware tool that can aid an organization's management and communication. A select number of users may have access to DVTC from their workstations. Key personnel at the geographically distributed research units and at ARI headquarters will then be within easy reach of one another. This will prove useful to ARI leadership since it will facilitate communication among the organization's leadership and provide a means to solve collaborative-oriented business problems. These users will require a Pentium-class machine to utilize DVTC.

The information systems migration plan will detail the implementation of recommended computing changes. This implementation will serve as the basis of an organizational information systems modernization plan that will outline continual upgrades and changes to the organization's information architecture. To monitor and manage the modernization program, yearly review of information resources by ARI is required.

2.1.2. Mainframe Connectivity

A requirement remains for connectivity to the databases of the National Institute for Health (NIH) and Personnel Command (PERSCOM).

Software connectivity must be maintained between the external mainframes and ARI's computing environment. There are several "middleware" applications available that integrate mainframe and client/server environments so as to maintain connectivity.

2.1.3 Printing

The goal for printer utilization in the Institute must be to optimize the use of available printing resources within ARI. A network's strength is its ability to make as many of its resources available to as many users as possible. This avoids unneeded duplication, thus providing a more cost effective use of ARI's resources.

The CSC Team recommends the minimization of standalone printers. Specific printers must not be dedicated to the exclusive use of one individual, section, or office unless there is a conscious management decision to do so.

All network users need access to color printers, as well as a high-speed printing capability. The information systems (IS) manager and staff can design and manage access to printer resources of the individual network domains. The IS staff can also assist users who need to access network-wide assets.

2.1.4 Specialized Hardware/Software Support

All network users must complete their transition from a Disk Operating System (DOS) environment and begin using Windows software as soon as possible. Prolonging the transition will only degrade user effectiveness in the long term. A Windows environment is the industry standard and is in widespread use throughout the Army.

It is recommended that the Institute transition to the Windows 95 operating system. Establishing a Windows 95 environment will ease network administration and position ARI to take advantage of future applications. ARI is in a good position to execute this transition easily since it is currently completing a Windows 3.11 upgrade that will allow ARI to step into the Windows 95 implementation without hesitation.

Scanners, color printers, and high-speed printers are several peripherals to which network users may need access on a periodic basis. In order for researchers to use these devices, it is essential that the researchers possess the software drivers to activate the hardware. Therefore, the CSC Team recommends that peripheral driver software be available to all users. It does not create an additional cost and is essential if users are to be able to fully utilize the full range of resources.

Network users must have access to all peripherals, such as scanners. Standalone low-density peripherals are expensive to ARI because multiple users are unable to access them.

2.1.5 License Management

Using servers to execute software applications reduces the efficiency of the network's communications capability. Instead, download software applications on to user workstations. With software at the users' workstations, application processing across the network is eliminated and network assets for other communications functions are made available.

ARI can manage application licensing restrictions with the use of commercial metering tools that regulate the number of users utilizing applications. Not all users require access to a given application simultaneously, so only the number of application licenses that are expected to be in use at any one time are required to be purchased. If the demand exceeds the number of software applications available, then

the metering software has the ability to restrict access until a user terminates the use of an application resource, thus making it available for others. Systems management staff will be able to monitor the use and demand of applications. This feature will allow the systems management staff to identify if additional licenses are required. The metering software can serve as a record of demands for license purchase justification.

2.2 Network Architecture

In designing a network architecture for ARI, the CSC Team evaluated alternatives based on the following criteria:

- Does it meet today's requirements?
- Is it open-ended with respect to migration strategies - will it accommodate tomorrow's requirements?
- Is it affordable - is the cost in line with what ARI is presently paying for communications and computing costs?

The components of network architecture that were evaluated and for which alternatives were developed were:

- Network Topology
- Network Operating System (NOS)
- File Services
- Print Services
- Mail Services
- Database Services
- Network Management

2.2.1 Network Topology

ARI's current network topology is a single 10 megabytes per second (Mbs) Ethernet-supporting DEC Pathworks NOS with the VAX cluster providing all network services (i.e., file, print, and mail). All network traffic flows over this network. The maximum loading capacity of Ethernet-type networks is 36%. Current network traffic over the ARI network is low; running between 10% to 15%. Network traffic loads over 36% result in a very high percentage of retransmitted packets, thus reducing the load capacity of the network. When the traffic at ARI includes more multimedia traffic (especially video traffic), network loading will increase, which will necessitate adjusting the network topology to accommodate the increased traffic.

ARI can increase its network capacity with either of two configurations:

- Segmented network with multiple low-speed (10Mbs) segments bridged together over a low- or high-speed backbone.
- Single high-speed (100Mbs) network

A single, high-speed network using Fast Ethernet or Fiberoptic Distributed Data Interface (FDDI) operating at 100Mbs will provide the necessary capacity that ARI requires. The existing ARI cable plant, which consists primarily of a thick Ethernet backbone and thin Ethernet cabling to the

workstations will not support the increased speed of 100Mbs. To support the increased speed, increased bandwidth optical fiber cabling, or high-speed twisted pair network cabling needs to be installed at ARI HQ. Figure 2.2.1-1 presents a single, high-speed network topology with high performance servers providing file, print, and mail services.

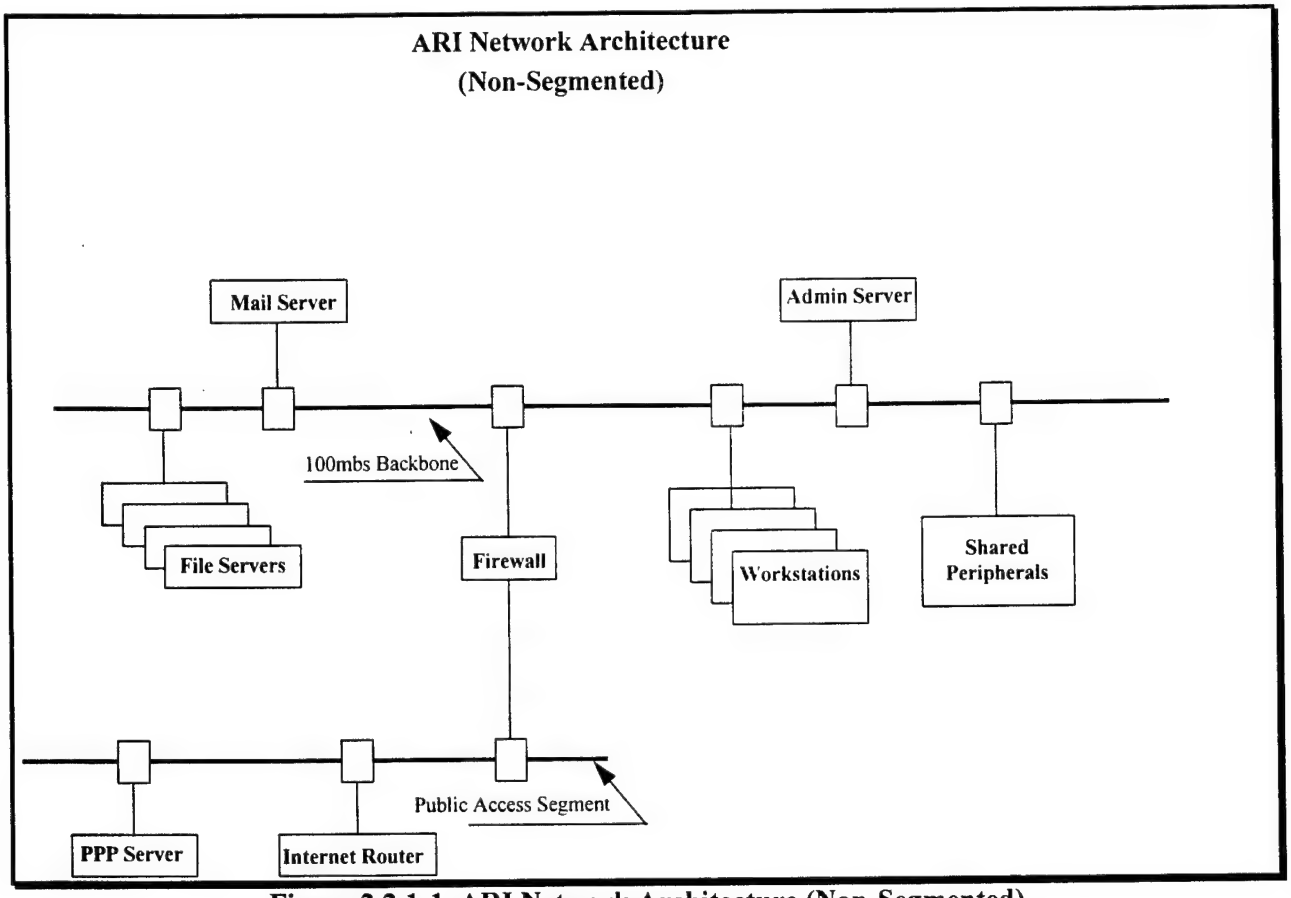


Figure 2.2.1-1 ARI Network Architecture (Non-Segmented)

Segmentation is effective if network resources, primarily file and print services, are localized with local traffic isolated from the backbone and other segments by routers. Network segmentation, with local file and print services on each segment, has the added advantage of reducing the effect of cabling or equipment failures. Figure 2.2.1-2 presents a segmented network topology, with a 100Mbs backbone and 10Mbs segments. This is a logical view of the network, and does not necessarily represent a physical layout.

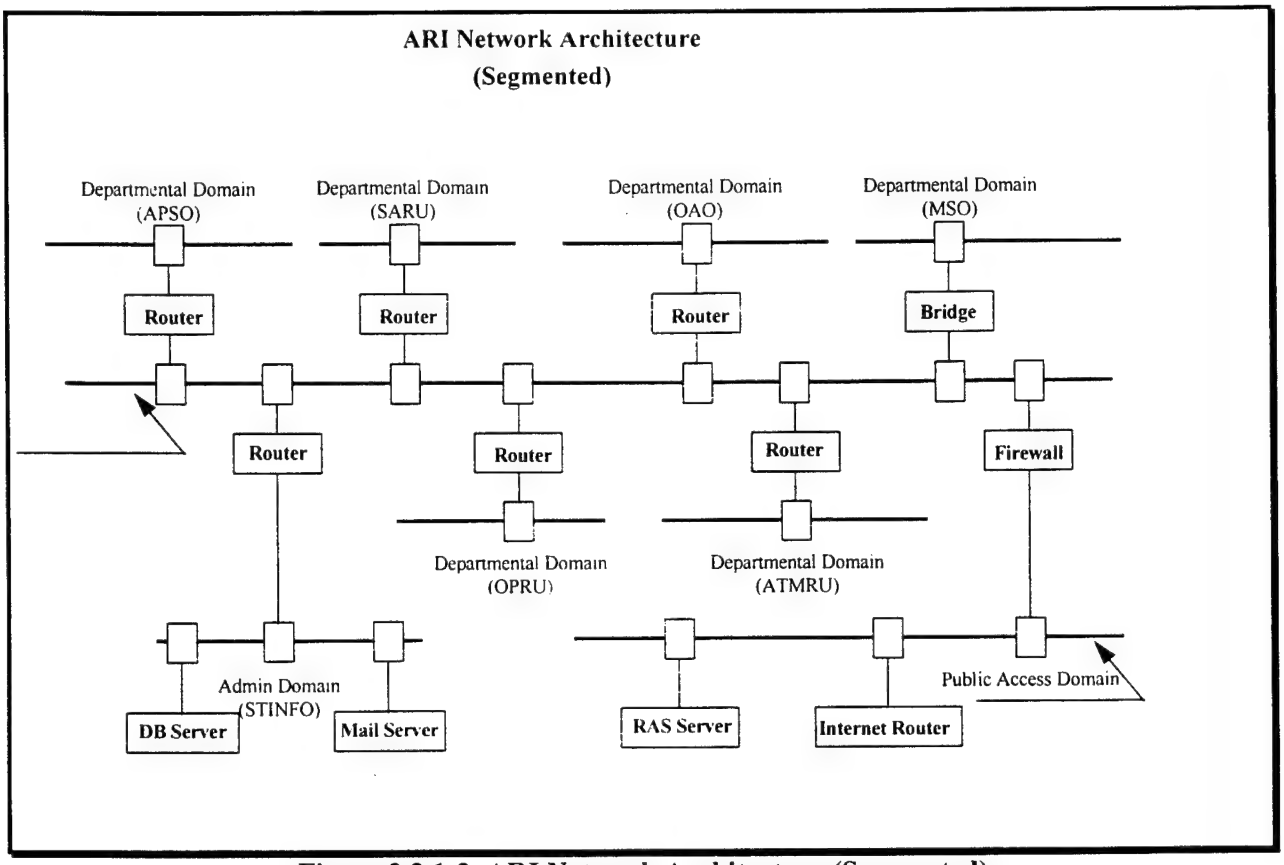


Figure 2.2.1-2 ARI Network Architecture (Segmented)

Figure 2.2.1-3 is a detailed view of a representative segment.

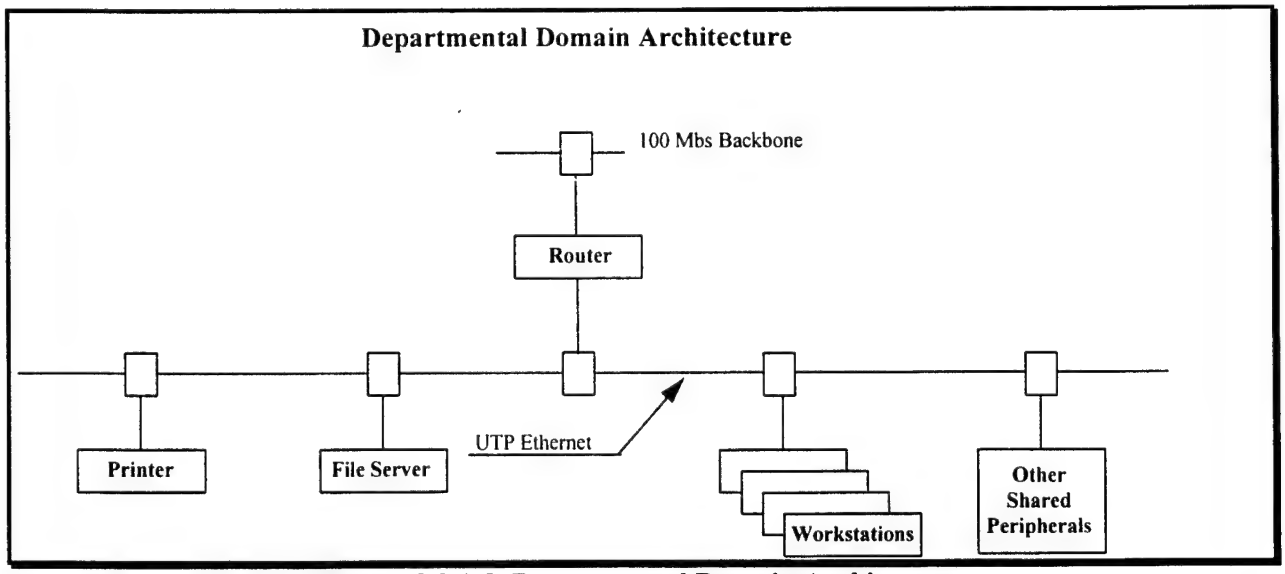


Figure 2.2.1-3 Departmental Domain Architecture

Moreover, the number of segments, routers, as well as file and print servers will be determined based on a detailed traffic engineering analysis.

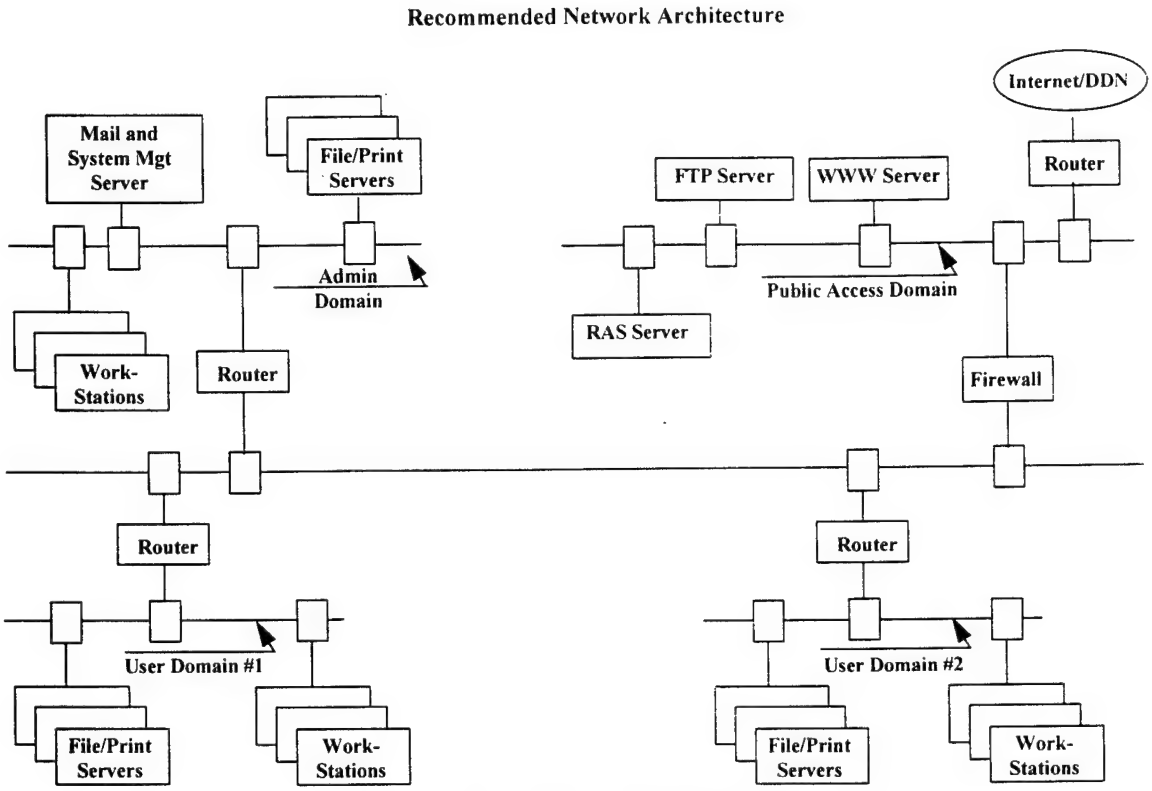


Figure 2.2.1-4 Recommended Architecture

For cost comparison purposes, the CSC Team, with the concurrence of ARI, assumed the network will consist of a segmented network with three segments. Routers add approximately $5000 each to the total network cost. File and print service costs for either topology are approximately the same. An unsegmented topology with Fast Ethernet or FDDI will require re-cabling. At a cost of $150 per connection at ARI HQ, for 200 connections, re-cabling costs may exceed $30,000.

Both network topologies, single high-speed and segmented, meet current ARI HQ requirements. Further, both network topologies are open-ended, and will meet future requirements over the next 10 to 15 years. The segmented approach may require improved cabling in the future to accommodate faster network speeds. Since the segmented approach more closely matches ARI's current topology, there is a straightforward migration strategy for using the segmented network. That is, replacing the DEC Local Network Interconnects (DELNI) and DEC MultiPort Repeaters (DEMPRs) circuitry with routers easily converts ARI's network into a three segment network. Table 2.2.1-1 shows the comparison of single segment versus multiple segments based on current and anticipated requirements and cost.

Table 2.2.1-1 Single and Multiple Segments

	Single Segment	Multiple Segments
Requirements -- Today	Yes	Yes
Requirements -- Tomorrow	Yes	Yes
Cost	High	Low

2.2.2 Network Operating System (NOS)

2.2.2.1 General Requirements The NOS chosen by ARI must provide, as a minimum, the following services:

- File services
- Print services
- Fault tolerance
- Remote access services
- Connectivity services for mini and mainframe computers
- Support for enterprise-wide network connectivity
- Macintosh and Intel Central Processing Unit (CPU) support

2.2.2.2 Alternative Network Operating Systems

Most of the major vendors in the NOS market provide systems that meet the above criteria. It is important that ARI select a system that meets these criteria, but that also has strong support both from the vendor and third parties that offer broad support of compatible software and hardware. Two NOS vendors stand above the rest: MS and Novell.

Over 70% of the LANs in the U.S.A. currently use a Novell NOS. Most of these LANs use Novell version 3.12 or earlier NOS, which does not support Wide Area Networks (WAN). Novell's version 4.0 NOS supported WANs, but had technical difficulties. The current version of Novell (4.1) corrects all problems associated with the earlier release. Therefore, Novell (4.1) is a robust NOS that will meet all ARI needs for the next five years.

MS Windows NTAS has been on the market for approximately two years. Partially because of Novell's problems with its early releases of their version 4.0, NTAS has enjoyed significant success. The success of NTAS directly contrasts the response to Microsoft's earlier NOS, LAN Manager. NTAS, like Novell (4.1), is a robust NOS that meets all the ARI criteria for the next five years

All other things equal, Windows NTAS Server's symmetric multiprocessing architecture (SMP) and its availability on multiple platforms makes NTAS the NOS of choice for ARI. SMP allows NTAS to support servers with multiple CPUs. NTAS servers with two or four Pentium processors are common, and can minimize server costs. Costs are reduced by using Pentium-based servers with multiple CPUs to get the server CPU power that is normally associated with more expensive Reduced Instruction Set CPU (RISC)-based servers. However, if ARI requires additional CPU power, NTAS is also available on: (1) the DEC Alpha; (2) an extremely fast CPU; (3) several UNIX-based systems running the Mips RISC processor; and (4) the new IBM/Motorola Power PCs.

2.2.2.3 Networking Protocols

Although the dominant networking protocol for local area networks is IPX/SPX, the native Novell protocol, TCP/IP is beginning to gain ground for LANs. Since TCP/IP is required for Wide Area Networking to include Internet access, most workstations that support IPX/SPX also support TCP/IP. NTAS supports the use of TCP/IP as a native networking protocol. An additional consideration at ARI-HQ is that AppleTalk for the Macintosh is required for Apple Macintosh workstation support. Both NTAS and Novell provide support for AppleTalk.

2.2.3 File Service

File service can be provided either by several smaller, relatively inexpensive servers or by one or more high performance, relatively expensive file servers. A segmented network with each segment supporting 40-60 users will typically use a single or dual Pentium file server. A network topology using a single high-speed network can use either multiple small file servers or a single, high performance file server. On a per-user basis, the smaller less-expensive file servers are more cost-effective but require more network management support. Good network management software and a file backup system that can provide unattended backup services for all file servers can mitigate the added network management cost of multiple small servers.

Table 2.2.3-1 - File Server Alternatives

	SMALL	LARGE
CPU	Dual Pentium	DEC Alpha
Quantity Required	4	1
Hardware Cost	$7500/CPU	$25000/CPU
Mass Storage	$750/GB	$1500/GB

2.2.4 Print Service

Print service is normally provided by either file servers or independent print servers located on the backbone or on individual segments; both Novell and NTAS support printers similarly. ARI has a large number of printers, many set-up as non-networked printers. The CSC Team recommends that consideration be given to setting up the non-networked printers as networked printers; even if their locations are not changed. Retired 386-based PCs make excellent print servers.

In addition to normal printing usually fulfilled by laserjet, inkjet, or dot matrix printers, there is a need for high-speed printing and high-quality color printing. Most print servers, including the above mentioned 386-based PCs, can handle print service. ARI has several high-speed printers. These are driven by the VAX and may need to be replaced when the VAX cluster is no longer available due to the DEC print drivers required by the printers.

2.2.5 Mail Service

A single mail server will suffice for ARI's E-mail requirements. If a high-performance file server is selected in lieu of multiple Pentium-class servers, it can perform double duty as a mail server. If multiple Pentium-class file servers are used, one single-CPU Pentium can serve both as a mail server and network management server.

2.2.6 Database Service

ARI has no stated need for a database server since the ARI database standard, MS Access, does not use a database server. MS Access is a file-based Database Management System (DBMS), similar to dBase, with database functions carried out by each client accessing the database. In the future, if ARI requires a server-based database engine, such as Oracle or Sybase, either of the proposed NOS and topologies can provide the necessary network support.

2.2.7 Network Management

In order to effectively manage their network with a minimum of labor, ARI requires smart network management tools that provide the following capabilities:

- Maintain an inventory of the hardware, software, and configuration of computers across a corporate network.
- Distribute, install, and update software and files.
- Manage network applications (applications that run over the network from servers).
- Provide integrated support utilities that enable viewing of diagnostic information for remote clients and direct control of clients.
- Provide an integrated network monitor utility that enables monitoring of network data flow.

Both Novell and NTAS provide these capabilities. Whichever NOS ARI selects, its architecture must include software and hardware tools that provide network management services.

2.3 Communications

Communications are the third component of ARI's Enterprise Information System Architecture. To meet ARI's telecommunications requirements for the next five years, the selected architecture must provide e-mail, remote access, Internet access, and desktop video teleconferencing support.

2.3.1 E-Mail

The CSC Team evaluated three e-mail products: MS Mail, IBM/Lotus ccMail, and IBM/Lotus Lotus Notes Mail. MS Mail and ccMail are standard e-mail products, providing "easy-to-use" e-mail functions. All types of document attachments are supported, including word-processing, text, graphics nd binary files. Of the e-mail products evaluated, ccMail is the more mature product and somewhat easier to use. However, MS Mail has the advantage of being better integrated into Microsoft operating systems, such as Windows for Workgroups, Windows 95, and Windows NT.

Lotus Notes with its mail component, Notes Mail, is more than simply an e-mail product. Notes Mail is comparable to ccMail or MS Mail, however, Notes also provides groupware functionality. Work centered around the passing of paper is easily modeled, thereby providing an ability to dispense with paper entirely. Processing requests for travel orders and travel reimbursements are typical examples of processes that can be made "paperless" through the use of groupware. In addition to e-mail and groupware, Notes provides industry-accepted electronic signatures. Notes also provides a capability to develop and field document databases. These can be used to easily implement bulletin boards and discussion groups.

Either ccMail or MS Mail will meet ARI's e-mail requirements. While Lotus Notes provides added value, it comes at extra expense. The CSC Team uncovered no compelling need at ARI for the added features of Notes to justify the additional expense of the Lotus Notes product.

2.3.2 Remote Access

ARI requires remote access services not only for external access to ARI Information System services at HQ, but also for HQ to access resources remote from ARI and other information providers. Remote access services are an integral part of NTAS. NTAS remote services also provide remote user access to Internet resources. Novell has a similar remote access service, albeit more difficult to administer. Extensive security controls in both NOS provide complete control of access to ARI and Internet resources.

2.3.3 Internet Access

Internet and DISN/DDN access are necessary for effective communications between ARI and its field units, as well as ARI and the rest of the digital world. The T1 node planned by ARI will provide very high-speed access to the Internet. Use of a commercial access provider may prove problematic in the future if the Defense Information Systems Agency (DISA) chooses to limit traffic between the DISN/DDN and the Internet. Access to some military sites may be limited since the commercial access provider cannot provide a military Internet address. Some military World-Wide-Web (WWW) sites are currently limiting access to users with military Internet addresses (.MIL). However, ARI's Internet node can easily be re-directed to a DISA provider if a commercial address at ARI proves to be a problem.

2.3.4 Desktop Video TeleConferencing (DVTC)

DVTC brings video, shared whiteboard, and shared applications to the workstation desktop. Several companies, led by Intel, are offering this capability. Cornell University has developed a shareware package called CU-SEE-ME that offers video teleconferencing capabilities. All of these packages require large amounts of bandwidth to realize full functionality.

Intel's ProShare product uses the Internet or point-to-point Integrated Services Digital Network (ISDN) services to provide full-motion video, as well as shared whiteboard and applications functionality. The minimum bandwidth requirement for Internet use is 128Kbs. Typical DVTC usage is for point-to-point connections. However, point-to-multi-point connections for full video teleconferencing involving more than two parties requires the use of a multi-point connection unit (MCU). These MCUs are relatively expensive at approximately $30,000 each. As an alternative to MCUs, most telephone operating companies (for example, Bell Atlantic in the Washington DC area) provide MCU services and can establish video teleconferencing between multiple parties for a fee.

Unlike Intel's ProShare, CU-SEE-ME software provides only video teleconferencing. CU-SEE-ME works with bandwidths ranging from 14.4Kbs to T1, but to get close to full motion video, CU-SEE-ME requires a minimum of 128Kbs bandwidth. Though no shared whiteboard or application functionality is innately available through CU-SEE-ME, it is available from third party vendors.

The DVTC was identified by the ARI community as a need while gathering requirements for ARI's Enterprise Information System Architecture. Either of the network architectures (high-speed/non-segmented or low-speed/segmented) will handle DVTC. If ARI decides to provide DVTC services, software for limiting network bandwidth must be included when DVTC is introduced. Otherwise, without an ability to throttle bandwidth allocated to DVTC, this service can quickly overload the network.

SECTION 3

3.1 Computing

3.1.1 Desktop Workstations

The minimum recommended workstation configuration is an Intel architecture Personal Computer with a 486/33 CPU, 8MB of internal RAM, 540GB of hard disk mass storage, CD ROM disk drive, 1.44MB 3.5" floppy disk drive, and audio capability that is Sound Blaster-compatible. The operating system is either Windows 95 or Windows NT, with Windows NT preferred on Pentium-class systems. All systems will have MS Office Suite software.

3.1.2 Mainframe Connectivity

All workstations must have the capability to access mainframe computers, either through terminal emulation software packages such as ProComm or Qmodem, or by using operating system utilities such as the Windows 95 terminal emulator utility or Telnet utility. External connectivity is recommended by shared modems on a communications server providing access through the public switched telephone network, or the Internet/DDN.

3.1.3 Printing

The 16 HP Laserjet 4I printers currently being used by ARI as network printers are foreseen by the CSC Team as sufficient for routine printing requirements during the next five years. It is recommended that at least two high-speed printers be placed on the network for general purpose use by all workstations.

3.1.4 Specialized Hardware/Software Support

Network Operating System (NOS) standardization on Windows 95 or Windows NT will ease system administration workload and position the Institute to take advantage of future improvements in software applications. Windows 95 will ease the transition of Macintosh users to the Intel PC architecture, since its user interface is very similar to the existing Macintosh interface.

Network users must have access to and knowledge of all peripherals available on the network. Standardization on a single family of operating systems (NT/95) will ease the burden of maintaining software drivers for all peripherals.

3.1.5 License Management

The CSC Team recommends that ARI begin using license metering software to control use of software in compliance with licensing constraints. The metering software allows the users to load and execute licensed software on their individual workstations. Also, the metering software is totally transparent unless the total number of simultaneous users has been reached. When total licenses are allocated, the metering software will display a message to the user and allow the user to "camp" the software request until a license is free. There are metering packages available today for MS Windows-based PC's that provide this capability.

3.2 Network Architecture

3.2.1 Network Topology

The CSC Team recommends that ARI's network architecture consist of a multi-segmented network topology using routers to localize traffic on each segment to the maximum extent possible. Figure 3.2.1-1 is a detail view of the proposed ARI network topology.

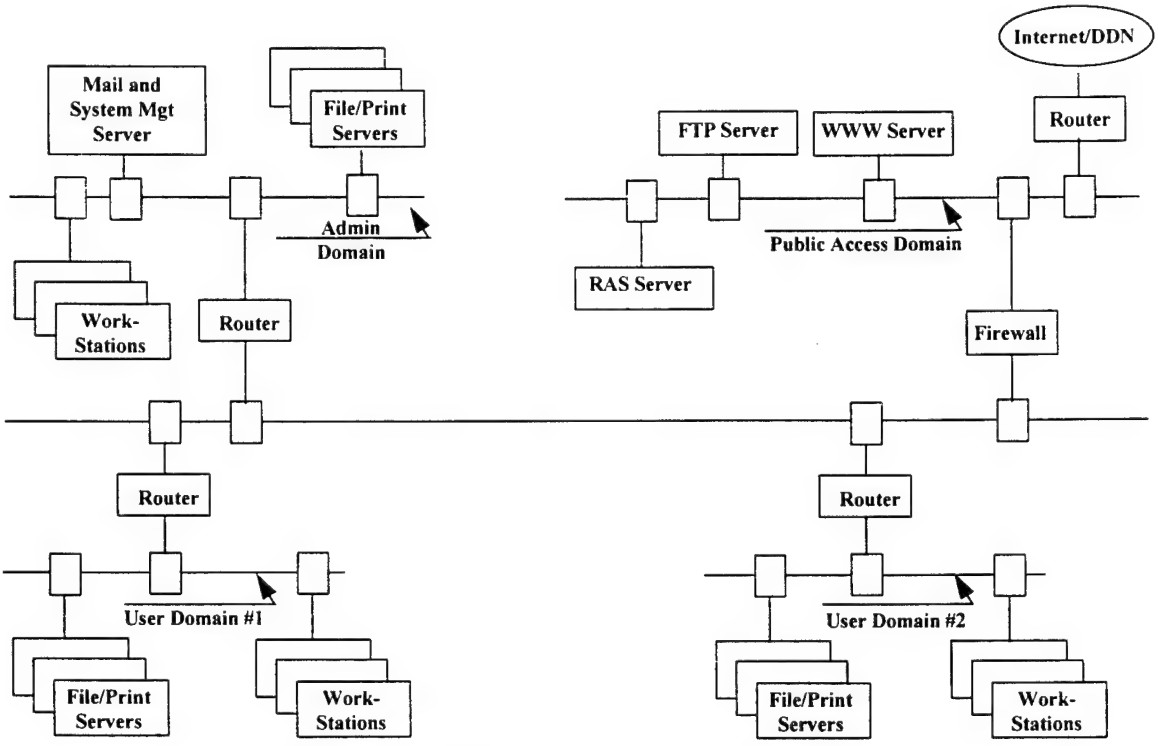


Figure 3.2.1-1 Recommended Network Architecture

ARI's network is presently segmented into three separate thin-Ethernet networks. These segments are interconnected using Digital Equipment Corporation's proprietary repeaters (DELNIs) and hubs (DEMPRs). The CSC Team recommends that ARI maintain this network topology until network traffic is heavy enough to warrant replacing the repeaters with a router.

3.2.2 Network Operating System

Either MS NTAS or Novell Netware 4.1 NOS will support the ARI HQ network requirements for an NOS. The CSC Team recommends NTAS because of its multi-platform and Synchronous Multi-Processing support.

3.2.3 Servers

Each segment must have its own file server, configured with memory and mass storage sufficient to support the users on the segment. The typical file server configuration consists of a dual 133Mhz Pentium CPU, 64MB of RAM, 10GB of hard disk storage with a minimum of 2GB mirrored, CD ROM disk drive, and a 1.44MB 3.5" floppy disk drive. The exact amount of RAM and mass storage for each file server is a function of the number of users, expected traffic, and the amount of mass storage required by the users. Consideration must be given to mirroring disk drives that contain critical network software or data. As a minimum, the drives that host the operating system for each server must be mirrored..

The CSC Team recommends that System Management Servers, mail servers, File Transfer Protocol (FTP) servers, WWW servers, and communications servers be configured with a single Pentium CPU with 64MB of memory and 2GB of mass storage, CD ROM disk drive, and 1.44MB floppy. The print server and mail server can initially be hosted on a common CPU. Since the FTP server, WWW server, and communications server all reside on the Public Access Domain, they can also be initially hosted on a common CPU.

Print servers can be hosted on any of the above servers, or on surplus 486 or 386 CPU's.

3.2.4 Network Management Services

The CSC Team recommends that the network management server be one of the first servers installed at ARI HQ. MS's System Management Server (SMS) provides all the network management software support required to manage this network. Support personnel must be trained early to use the SMS to:

- Maintain inventory of hardware, software, and configurations of computers.
- Distribute, install, and update software and files
- Manage network application.

Use of this package from the beginning will greatly facilitate the transition from the VAX and Pathworks to the new NOS.

3.2.5 E-Mail

The mail server must be the first server installed. ARI can begin reaping benefits from an improved mail service immediately, and MS Mail is compatible with the existing ARI network. MS Mail is highly recommended by the CSC Team to be ARI's selected mail package because of its integration with the MS Office suite of software and its inclusion in the Windows 95 operating system. Additionally, MS Mail can be integrated with groupware such as Lotus Notes at a later date if ARI decides to invest in groupware.

3.2.6 Remote Access

NTAS Remote Access Services (RAS) provides an easy-to-use, virtually transparent communications service to MS Windows clients. RAS can be hosted on the same server as the WWW server and the FTP server. Also RAS provides the same type of service as the existing modem pool currently used by ARI. The server hosting this service will require a multi-port serial board, depending on the number of modem to be shared. The CSC Team recommends that ARI also consider upgrading all shared modems to high-speed 28.8 modems.

3.2.7 Internet Access

The CSC Team foresees ARI's plans for Internet access as providing sufficient bandwidth for the next two to five years. If DISA reduces the prices for T1 access to the DISN, the CSC Team recommends that ARI switch from a commercial access provider to DISA, to gain the advantage of having a military Internet address (.MIL) instead of a Government address (.GOV).

Appendix A
List of Acronyms

ARI	Army Research Institute
CD	Compact Disk
CD-ROM	Compact Disk- Read Only Memory
CPU	Central Processing Unit
DBMS	Database Management System
DDN	Defense Data Network
DELNI	DEC Local Network Interconnects
DEMPR	DEC MultiPort Repeaters
DISA	Defense Information Systems Agency
DISN	Defense Information Support Network
DOS	Disk Operating System
DVTC	Desktop Video TeleConferencing
FDDI	Fiberoptic Distributed Data Interface
FTP	File Transfer Protocol
IS	Information Systems
ISDN	Integrated Services Digital Network
LAN	Local Area Network
Mbs	Megabyte Per Second
MCU	Mult-point Connection Unit
MS	Microsoft
NIH	National Institute of Health
NTAS	NT Advanced Technology
NOS	Network Operating System
PC	Personal Computer
PERSCOM	Personnel Command
RAS	Remote Access Services
RISC	Reduced Instruction Set Computing
SMP	Symmetric Multiprocessing Architecture
SMS	System Management Server
NT	New Technology
WAN	Wide Area Network
WWW	World Wide Web

ARI's Enterprise Information Systems Architecture and Strategic Plan Support

DRAFT
Requirements Report

4 December 1995

Prepared for:

U.S. Army Information Systems Command - Army Research Institute
ATTN: Mr. Nathaniel Speight
5001 Eisenhower Avenue
Room 6S58
Alexandria, VA 22333-5600

Contract Number: DCA 100-94-D-0014
Delivery Order Number: 171
CDRL Number: 005

Prepared by:

Computer Sciences Corporation
Defense Enterprise Integration Services
5113 Leesburg Pike
Skyline 4, Suite 700
Falls Church, VA 22041

THIS DOCUMENT IS UNCLASSIFIED

Table of Contents

List of Appendices

Section 1
1.1 Introduction

This document contains the results of the requirements analysis performed the CSC Team at the Army Research Institute HeadQuarters (ARI HQ). The contents are separated into two sections. The first section provides a summary of the requirements analysis and the conclusions drawn from that analysis. The second section contains the detailed requirements divided into major categories.

The ARI HQ realized that their current computing environment needed to be evaluated to identify the current capabilities and how to best meet their requirements in the coming years. The CSC Team was tasked by ARI with the project of analyzing the ARI automation capabilities and requirements. The findings from the analysis of the ARI environment will serve as the foundation for the CSC Team's recommendation of alternative architectures for ARI HQ. Based on the ARI-selected architecture, the CSC Team will develop an implementation plan to be used by ARI in FY96. For detailed information concerning the current processing capabilities, review the ARI Information Systems Architecture Capabilities Report.

1.2 Executive Summary

Through the combined use of written surveys and in-person interviews, the CSC Team collected and documented the requirements of the ARI community. Surveys were distributed by ISC within the ARI organization, both at headquarters and at field units. In-person interviews were conducted by VRI and ISC at ARI HeadQuarters. The CSC Team also performed an in-person interview with one field unit, Fort Knox, KY. Telephonic interviews were conducted by the CSC Team with six of the field units (Fort Benning,GA; Fort Leavenworth, KS; Fort Rucker, AL; West Point, NY; Orlando, FL; and Fort Monroe, VA).

The offices interviewed at HeadQuarters included Army Personnel Survey Office (APSO), Scientific and Technical Information Office (STINFO), Management Support Office (MSO), Occupational Analysis Office (OAO), Research Advanced Concepts Office (RACO), and Plans, Programs, and Budget Office (PPB). The in-person interviews at ARI headquarters stratified the participants so that people with similar job responsibilities were interviewed together. Using this technique to group researchers with other researchers and secretaries with other secretaries, ARI senior management hoped to encourage candor from interview participants. Another benefit of the stratification was an overlap of skills among the participants so that any unavoidable absentees did not diminish the data provided by the group.

1.3 Conclusions

The CSC Team analyzed the requirements supplied through the surveys and interviews. They revealed needs for improved internal and external communications; a more

responsive e-mail system; and increased knowledge and access of available network resources at ARI HQ. The information provided by the ARI community showed that the VAX cluster is primarily required for access to e-mail, bulletin boards, and data storage. Therefore, the capability that the VAX cluster of minicomputers provides remains a requirement, but not necessarily the VAXs itself because less expensive alternatives exist that perform the required functions more efficiently.

Section 2

2.1 Computing

2.1.1.1 Personal Computers (PC). ARI's data processing infrastructure relies on IBM-compatible PCs as the primary user workstation. This will continue into the next century. These workstations must be equipped to allow users to execute stand-alone PC-based applications, access and use resources on the Local Area Network (LAN), perform analysis on large datasets, and provide support for future technological developments at the desktop level.

The minimum configuration required for ARI includes an IBM-compatible PC (486/33 processor) or a Pentium-based PC with 32 MB of Random Access Memory (RAM), 1 GB hard drive storage, and a CD-ROM capability.

2.1.1.2 Macintosh Computers. Though the Macintoshes represent less than 10% of the total ARI desktop computing, they are considered essential by the researchers who use them. Officially, any resources directed to the Apple Macintosh platform will not be supported by the Institute. Still, because the Macintosh platform is essential to their users, they must be supported by whatever information systems architecture that ARI adopts.

2.1.1.3 Laptop and Notebook Computers. Laptops and notebooks used by ARI researchers will continue to be a requirement for data collection in the field. Additionally, laptops and notebooks permit rapid turnaround of data analysis during site visits.

2.1.1.4 NeXT PC. The NeXT computer is a closed architecture computer that does not support open systems engineering. Therefore, the NeXT computer will not support the multi-platform growth to which ARI HQ is dedicated. The NeXT computer has a UNIX-based operating system, which constitutes a minority of the work performed at the Institute. However, the researchers using the NeXT computer strongly endorse the upgrading of the current NeXT PC to a NeXT Step 3 regardless of the limitations of the platform.

2.1.2 Mainframe

The cluster of Digital VAX minicomputers at ARI HQ is grossly under-used causing the resources directed to their maintenance to be a drain of ARI resources rather than an asset. The VAX platform is maintenance-intensive as compared to workstations. Since the VAXs are under-used, the resources directed to their upkeep are not being applied most efficiently. However, the capabilities that the VAX cluster provides to ARI HQ of shared peripherals (i.e. disk storage devices, tape drives, and printers), as well as access to relational database resources, programming languages, other software applications, and external computer resources remain a requirement. Also, ARI HQ's role as a central data exchange for eight ARI field sites, six Research Units, and nine Coordination/Research Elements must be maintained.

2.1.2.1 Operating System. Desktop PC workstations will require a minimum operation system of MS-DOS 6.0 with Windows. The network services will require servers capable of supporting an open system environment (OSE).

2.1.2.2 External Connectivity. ARI's requirements for external connections are increasing, including those with the international community and on the Internet. The requirement to easily interface with systems external to ARI HQ is a priority issue for the ARI community.

2.1.3 Printers

The printers at ARI HQ need to be shared as much as possible to provide more effective use of resources. High-speed printers will continue to be required, particularly for surveys. Also, color printing is becoming an increasing requirement for presentations and briefings. Thus, increased access to color printers, in addition to faster color printing have been identified as a requirement for ARI HQ. A need for a printer that allows film development has been identified by the publishing office in order to reduce service bureau costs. Due to the continued use of Macintosh PC's, printers chosen for ARI must also support the Macintosh platform. Any replacement printers must be able to support the multiple protocols of different platforms in an OSE.

2.1.4 Software

ARI HQ's LAN must continue to provide users at HQ with access to PC-based software products. ARI has identified software standards that will be used by the Institute as the basis for ARI's office automation path. The currently identified standards support the Microsoft (MS) Office suite of tools, (i.e. Word, Access, Excel, and PowerPoint). While training is being provided by ARI for MS Office, the need for documentation on the MS Office packages, as well as other available software packages, has been cited by individuals in the ARI community.

2.1.4.1 Word Processing. MS Word is the ARI's standard for word processing. However, WordPerfect will still be required in the ARI community due to deliverable formatting requirements of existing contracts.

2.1.4.2 Database Management Systems. MS Access (v 2.0) has been identified by ARI as the standard organizational database software. It will be necessary to procure a more powerful database engine to use as the back-end to MS Access to most efficiently support the large dataset analysis that is performed by ARI.

2.1.4.3 Spreadsheets. The ARI organizational standard for spreadsheets is MS Excel. No future changes are expected.

2.1.4.4 Graphics. MS PowerPoint is the Institute's graphics standard. However, additional training of ARI staff is required to ensure wider, more effective use of the tool.

2.1.4.5 Communication. The current communications capabilities of ARI HQ include Reflections, available through Pathworks, ProComm and SmarTerm 340, as well as Telnet. The ARI community requires more seamless communications capabilities from its software packages than are currently provided by the available packages.

2.1.4.6 Statistic Package. Statistical Package Social Sciences (SPSS) for PC is used by ARI, but users require the upgraded SPSS for Windows. Several researchers identified the need for a statistical package with improved data presentation ability, such as professional-quality briefing graphics.

2.1.4.7 Electronic Mail. The current ARI electronic mail package available with the Pathworks network: Pathworks e-mail does not satisfy users' requirements for file attachments. The e-mail package chosen for ARI HQ must permit a nearly transparent interface to the user. The e-mail package must be able to transfer multiple file types, such as graphics, electronic forms, and word processing. In addition, the selected e-mail package must allow the user to open the attachments within the e-mail package.

2.1.4.8 Desktop publishing. Ventura Publisher, CorelDraw, and PhotoShop continue to be required for desktop publishing. Additionally, more advanced graphics and typesetting support, such as Quark Express for Windows, has been identified as a requirement by the ARI publishing community.

2.1.4.9 Programming languages. ISC develops and maintains some custom-designed software for the ARI community on an as needed basis. Programming support remains a requirement for the Institute.

2.1.4.10 Time management. An improved time management software package is required by ARI before wide-spread use of the tool will occur. The package chosen must be easy to use and allow viewing of others' calendars.

2.1.4.11 Utilities. The need for a HyperText Mark-up Language (HTML) editor has been identified to support the move into the Internet and World-Wide-Web (WWW) arena. In keeping with the ARI standard of MS Office, MS Word can be used as an HTML editor with some add-on packages.

Because users at ARI HQ require access to software packages, but not simultaneously, ARI requires a software licensing management software utility that will reduce licensing costs.

2.1.4.12 Miscellaneous Other Software Issues. Windows (v 3.1) is the required operating system of ARI's IBM-compatible 386 and 486 PCs.

2.2 Networking

2.2.1 Internal. ARI HQ requires an increased network capacity to allow for transmission of multimedia. Also, improved Internet/Defense Data Network (DDN) connectivity is required to support the increased use of data collection and exchange. The existing peripherals at ARI HQ, such as scanners, need to be made more widely available to the users through the ARI LAN. Increased mass storage is a critical need of the ARI LAN users.

2.2.2 External. ARI requires connectivity to the National Institute of Health (NIH) mainframe to allow ARI personnel to submit and execute remote jobs at NIH. Additionally, ARI must maintain its connectivity to the other external AIS, such as HeadQuarters Department of the Army (HQDA) DSS and the Defense Technical Information Center (DTIC) system, to which it currently has access.

2.3 Communications. Users are on the whole dissatisfied with the Pathworks LAN and its inherent communication capabilities. A more transparent communications package is required at ARI that will support the information exchange requirements of the ARI HQ including e-mail, remote access, electronic data transfer between HQ and Field Units, modems, and Desktop Video TeleConferencing (DVTC).

2.3.1 E-mail. The current e-mail package has limited usage throughout ARI HQ because it does not fully support the needs of the community. Since exchange of information through e-mail has been identified by ARI as essential, an improved e-mail package is required to support the Institute.

2.3.2 Facsimile. No additional future requirements were identified beyond the current capability available at ARI HQ.

2.3.3 Groupware. Collaborative work software that permits simultaneous access to graphics, documents, workflow, and "white boards" has been identified within the ARI community as a requirement of the ARI computing environment.

2.3.4 Remote Access. Modems for dial-out ability to Bulletin Board System (BBS) and DSSW Automated Requisition Tracking System (DARTS), as well as to NIH and the field units continue to remain a requirement for the Institute.

2.3.5 Internet Access. ARI's information system must continue to allow access to the Military Operational Communications Network (MILNET) and ARPANET. In addition, researchers have cited a requirement for Web browsers to expand their access to relevant available information. To promote broader data exchange, there is a need to have an ARI "Home Page" created on the Internet. Through the ARI Home Page, external organizations would be able to access ARI to exchange data and receive published materials.

2.3.6 Desktop Video Teleconferencing. Several researchers and directors identified DVTC as a future requirement of the ARI HQ computing environment infrastructure in order to offset travel cost.

2.4 Support Services

2.4.1 Application Programming. There are two different options of obtaining application programming support: in-house by ISC or externally by contractors. These methods of obtaining programming support remain a requirement by the ARI community.

2.4.2 Electronic Forms. The use of electronic forms remains a requirement of ARI. However, the current package, FORMflow is not fully satisfactory to the users. Therefore, either additional training on the Form Filler component of FORMflow is required or selection of another package more suited to the profile of the ARI user.

2.4.3 Technical Training. A need for sustainment-level software training, in addition to training on newly acquired software packages, has been identified by the ARI community.

2.4.4 Telephone VoiceMail. Several individuals at ARI HQ identified a need for expanded VoiceMail accounts on the telephone system at ARI HQ.

2.4.5 Multimedia. Multimedia has an instrumental role in ARI simulation and training. Therefore, ARI HQ has a requirement for full motion video and integrated audio capability. To support multimedia, however, ARI HQ needs to acquire equipment that provides the integrated multimedia capabilities.

2.4.6 Help Desk/User Support. The current capability remains a requirement into the future.

2.4.7 Software support. Several ARI employees are proficient in the various software applications used at ARI, however, no one person is designated at ARI as an expert resource to other employees having software questions or problems. Having a statistician on staff who is also knowledgeable of the software packages in use at ARI was identified as a requirement by the ARI community of researchers and surveyors.

2.5 Computer Services

2.5.1 Off-Site Computer Services. The current agreements with outside service organizations to support the information management requirements that exceed the in-house resources remains a requirement.

- NIH,
- HQDA DSS,

- APG Reporting System,
- PERSCOM system,
- Total Authorized Document System (TADS),
- The DTIC system,
- DA Public Affairs,
- Electronic Timekeeping System (ETS),
- Comprehensive Occupational Data Analysis Program (CODAP),
- Automated System Approach to Training (ASAT),
- Automated Instruction Management - Revised (AIMS-R),
- Army Science and Technology Management Information System (ASTMIS)
- Access to O-Net
- Manpower And Technical Resource Information System (MATRIS).

2.5.2 In-House Capabilities

2.5.2.1 Document Archival Retrieval System (DARS). The requirement for propagating the DARS technology for contracts and research data management has been identified by the ARI community.

2.5.2.2 Integrated Library System (ILS). The capability to access ILS, a catalog, search and retrieval system for the ARI Technical Resource Center (TRC) for uploading and downloading information from the DTIC remains a requirement by the ARI community.

2.5.2.3 Technical Information Division Management Information System (TIDMIS). The migration of TIDMIS from the VAX (Datatrieve) to MS Access on the PC has been identified by the ARI publishing office.

2.5.2.4 DA Property Inventory System. The migration of the internal USAISC-ARI Property Inventory System from Oracle on the VAX to MS Access on the PC has been identified as a requirement by ARI HQ.

2.5.2.5 Interim Management Information System (IMIS). The migration of IMIS from the VAX to the PC has been identified as a requirement by the ARI community.

2.6 Security Considerations. The current processing consideration of Sensitive data due to privacy issues and For Official Use Only (FOUO) constraints remains an essential requirement of the Institute. The capability for network backups to include selected individuals' workstation files is required to prevent critical data loss due to lack of individual back-up procedures.

Appendix A

AIMS-R	Automated Instruction Management - Revised
APSO	Army Personnel Survey Office
ARI	Army Research Institute
ARPANET	Advanced Research Projects Agency Network
ASAT	Automated System Approach to Training
ASTMIS	Army Science and Technology MIS
BBS	Bulletin Board Systems
CODAP	Comprehensive Occupational Data Analysis Program
COTS	Commercial Off-The-Shelf
DSS	Decision Support Systems
DARS	Document Archival Retrieval System
DARTS	DSSW Automated Requisition Tracking System
DDN	Defense Data Network
DTIC	Defense Technical Information Center
DVTC	Desktop Video TeleConferencing
ETS	Electronic Timekeeping System
FOUO	For Official Use Only
HQDA	HeadQuarters Department of the Army
ILS	Integrated Library System
IMIS	Interim Management Information System
ISC	Information Systems Command
LAN	Local Area Network
MATRIS	Manpower And Technical Resource Information System
MILNET	Military Operational Communications Network
MS	Microsoft
MSO	Management Support Office
NIH	National Institute of Health
OAO	Occupational Analysis Office

OSE	Open Systems Environment
PC	Personal Computer
PPB	Plans, Programs, and Budget Office
RACO	Research Advanced Concepts Office
RAM	Random Access Memory
SPSS	Statistical Package Social Sciences
STINFO	Scientific and Technical Information Office
TADS	Total Authorized Document System
TIDMIS	Technical Information Division Management Information System
TRC	Technical Resource Center
USAISC-ARI	U.S. Army Information Systems Command - Army Research Institute